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(54) 【発明の名称】 ポリカーボネート積層位相差フィルム

(57) 【要約】

【課題】 本発明の目的は、耐熱性、成形性等が良好なポリカーボネートを用いた、視野角特性の改善された位相差フィルムを提供することにある。

【解決手段】 波長550nmにおける三次元屈折率が下記式(1)を満足する、例えばメチル基を有するフルオレン骨格を主成分とするポリカーボネートからなる負の屈折率異方性を有する位相差フィルムと、波長550nmにおける三次元屈折率が下記式(2)

$$n_x < n_z \quad (1)$$

$$n_x > n_z \quad (2)$$

(上記式(1)、(2)中、 n_x はフィルム面内における主延伸方向の屈折率であり、 n_z はフィルム面に対して法線方向の屈折率である。)を満足するポリカーボネートからなる正の屈折率異方性を有する位相差フィルムの積層体からなることを特徴とするポリカーボネート積層位相差フィルム。

【特許請求の範囲】

【請求項1】 波長550nmにおける三次元屈折率が下記式(1)を満足するポリカーボネートからなる負の屈折率異方性を有する位相差フィルムと、波長550nmにおける三次元屈折率が下記式(2)を満足するポリカーボネートからなる正の屈折率異方性を有する位相差フィルムの積層体からなることを特徴とするポリカーボネート積層位相差フィルム。

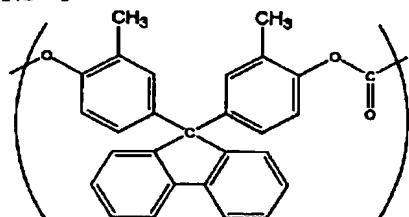
$$【数1】 \quad n_x < n_z \quad (1)$$

$$n_x > n_z \quad (2)$$

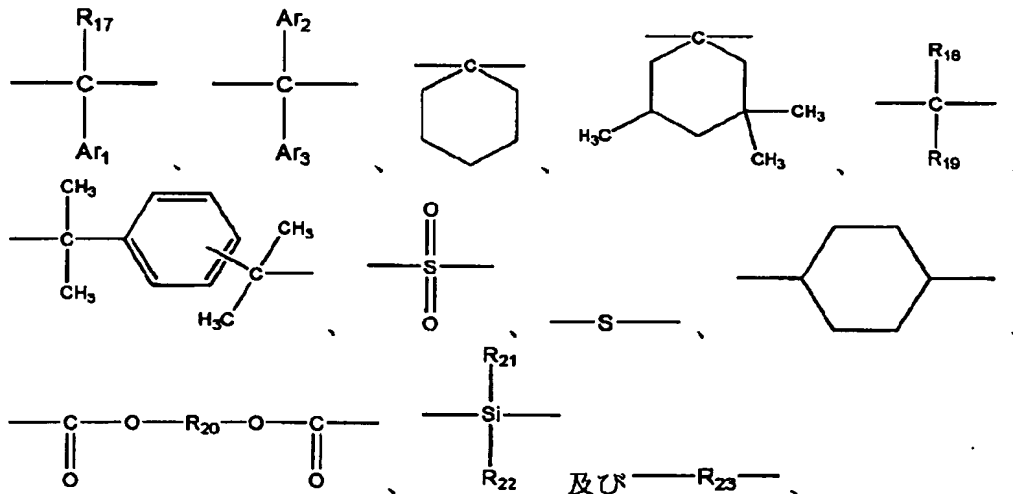
(上記式(1)、(2)中、 n_x はフィルム面内における主延伸方向の屈折率であり、 n_z はフィルム面に対して法線方向の屈折率である。)

【請求項2】 負の屈折率異方性を有する位相差フィルムが、下記式(3)

【化1】



(3)

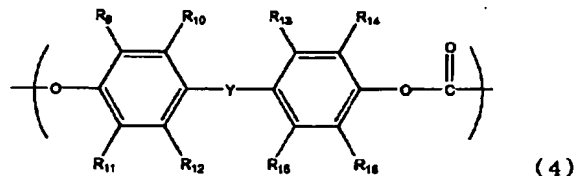


(上記式群中、 $R_{17} \sim R_{19}$ 、 R_{21} 、 R_{22} はそれぞれ独立に水素原子、ハロゲン原子及び炭素数1～22の炭化水素基から選ばれ、 R_{20} 及び R_{23} はそれぞれ独立に炭素数1～20の炭化水素基から選ばれ、また、 $Ar_1 \sim Ar_3$ はそれぞれ独立に炭素数6～10のアリール基から選ばれる。)で示される繰り返し単位とからなるポリカーボネートからなり、かつ上記式(3)で表される繰り返し単位は該ポリカーボネート全体の71～98モル%を占め、上記式(4)で表される繰り返し単位は29～20モル%を占めることを特徴とする請求項1に記載のポリカーボネート積層位相差フィルム。

【請求項3】 負の屈折率異方性を有する位相差フィルムが、下記式(4)

で示される繰り返し単位と、下記式(4)

【化2】



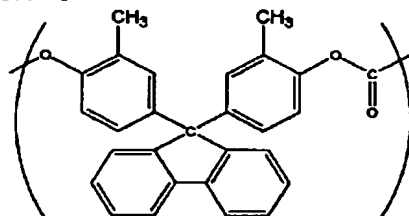
(4)

(上記式(4)において、 $R_9 \sim R_{16}$ はそれぞれ独立に水素原子、ハロゲン原子及び炭素数1～3の炭化水素基から選ばれ、 Y は下記式群

【化3】

ムが、下記式(3)

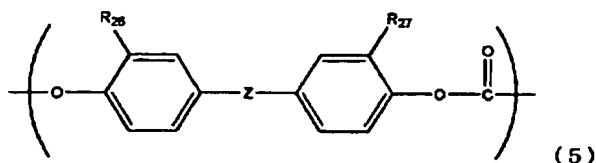
【化4】



(3)

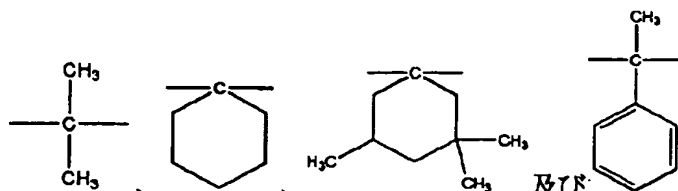
で示される繰り返し単位と、下記式(5)

【化5】



(上記式(5)においてR26及びR27はそれぞれ独立に水素原子、メチル基から選ばれ、Zは下記式群

【化6】



から選ばれる。)で示される繰り返し単位とから構成されるポリカーボネートからなり、かつ上記式(3)で表される繰り返し単位は該ポリカーボネート全体の72～96モル%を占め、上記式(5)で表される繰り返し単位は28～4モル%を占めることを特徴とする請求項1または2記載のポリカーボネート積層位相差フィルム。

【請求項4】 負の屈折率異方性を有する位相差フィルムの測定波長450、550nmにおける位相差値R(450)、R(550)の関係が、下記式(6)

【数2】

$$R(450)/R(550) < 1 \quad (6)$$

で表されることを特徴とする請求項1～3のいずれかに記載のポリカーボネート積層位相差フィルム。

【請求項5】 上記負の屈折率異方性を有する位相差フィルムと、正の屈折率異方性を有する位相差フィルムとを、両方の位相差フィルムの面内の屈折率最大方位が直交するように積層してなることを特徴とする請求項1～4のいずれかに記載のポリカーボネート積層位相差フィルム。

【請求項6】 四分の一波長板であることを特徴とする請求項1～5のいずれかに記載のポリカーボネート積層位相差フィルム。

【請求項7】 請求項1～6記載のポリカーボネート積層位相差フィルムを偏光フィルムと積層させたことを特徴とする積円偏光フィルム。

【請求項8】 請求項1～6のいずれかに記載のポリカーボネート積層位相差フィルム及び請求項7記載の積円偏光フィルムを用いてなることを特徴とする液晶表示装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】 本発明は耐熱性、成形性等が改良されたポリカーボネートからなる負の屈折率異方性を持つ位相差フィルムと、ポリカーボネートからなる正の屈折率異方性を有する位相差フィルムを組み合わせることに伴う、用途に応じて視野角特性を任意に制御することが出来る位相差フィルムに関する。これらの位相差フィルムを用いることにより、光学特性が改良された液

晶表示装置を提供することができる。

【0002】

【従来の技術】 位相差フィルムはSTN(スーパーツイステッドネマチック)方式等の液晶表示装置において、色補償、視野角拡大等の問題を解決するために用いられている。一般に、色補償用の位相差板の材料としてはポリカーボネート、ポリビニルアルコール、ポリスルホン、ポリエーテルスルホン、アモルファスポリオレフィン等が用いられ、視野角拡大用の位相差板材料としては前記した材料に加えて高分子液晶、ディスコチック液晶を硬化させたもの等が用いられている。

【0003】 熱可塑性高分子フィルムを用いた位相差フィルムは一般に一軸延伸工程により、屈折率異方性を発現させているが、通常の一軸延伸では得られるフィルムの異方性も一軸性となり、例えば正の屈折率異方性を有する高分子材料の場合、膜厚方向の屈折率のみを面内の屈折率の1つよりも高くするといったことが困難である。膜厚方向の屈折率を面内の屈折率の1つよりも高くすることができなくても使用可能な用途はあるが、液晶表示装置の視野角を改善するといったことを位相差フィルムで行う場合には、このような膜厚方向の制御が必要となる場合がある。

【0004】 膜厚方向の屈折率を高くする方法としては、例えば、膜厚方向に延伸する方法や、負の屈折率異方性を持つ位相差フィルムと正の屈折率異方性を持つ位相差フィルムを積層させる方法等が提案されている。

【0005】

【発明が解決しようとする課題】 しかし、膜厚方向に延伸する方法は非常に生産性が悪くコストが著しく高くなってしまったといった問題がある。また、負の屈折率異方性を持つ位相差フィルムと正の屈折率異方性を持つ位相差フィルムを積層させる方法においては、負の屈折率異方性を有する位相差フィルムとして、ポリスチレン、ポリメチルメタクリレートや高分子液晶を垂直配向させたものを用いる技術が開示されている。しかし、これらの負の屈折率異方性を有するフィルムは熱的耐久性に乏しいものが多く、また成形性が悪い、高分子液晶のように煩雑な配向処理を必要としたり、また材料コスト自身が

高い等の問題があり、市場には出回っていないのが現実であった。

【0006】本発明は上記課題を解決し、耐熱性、成形性等が良好なポリカーボネートを用いた、視野角特性の改善された位相差フィルムを提供することにある。

【0007】

【課題を解決するための手段】本発明者らは、優れた光学特性を有する材料について広く検討を行っているが、位相差フィルムは光学用途であるので、その測定波長において光吸収が少なく透明である材料、また、耐熱性の観点からガラス転移点温度としては140℃以上、より好ましくは150℃以上を有する材料、そして成形性の点で有利な材料として、高分子材料、特に熱可塑性高分子材料に注目してきた。

【0008】本発明者らはポリカーボネートのうち、ある特定の高分子構造を有するときに、耐熱性をもちつつ成形性も良好でありながら負の屈折率異方性を発現させ得ることを見出した。

【0009】すなわち本発明は、波長550nmにおける三次元屈折率が下記式(1)を満足するポリカーボネートからなる負の屈折率異方性を有する位相差フィルムと、波長550nmにおける三次元屈折率が下記式

(2)を満足するポリカーボネートからなる正の屈折率異方性を有する位相差フィルムの積層体からなることを特徴とするポリカーボネート積層位相差フィルムである。

【0010】

【数3】 $n_x < n_z$ (1)

$n_x > n_z$ (2)

(上記式(3)中、 n_x はフィルム面内における主延伸方向の屈折率であり、 n_z はフィルム面に対して法線方向の屈折率である。)

【0011】本発明で言う屈折率異方性とは三次元屈折率によって規定されるが、まずはこの三次元屈折率について説明する。三次元屈折率は n_x 、 n_y 、 n_z で表され、それぞれの定義は、

n_x ：フィルム面内における主延伸方向の屈折率

$$N_z = (n_x - n_z) / (n_x - n_y) \quad (6)$$

があるが、正の屈折率異方性を有する高分子材料からなるフィルムを通常の方法で一軸延伸または二軸延伸しただけでは $N_z \geq 1$ 、すなわち $n_x > n_y \geq n_z$ または $n_x \approx n_y > n_z$ であり、斜めから見ても位相差値がほとんど変化しない $N_z = 0.5$ は達成することが困難である。 $N_z = 0.5$ にするには $n_x > n_z > n_y$ となることが必要だが、先述の積層体ならこれを達成することが可能であり、該積層体は $N_z < 1$ の範囲で光学異方性を制御できることが特徴である。例えば、液晶表示装置の光学設計にもよるが、 $N_z = 0.5$ なる位相差フィルムを液晶表示装置に用いた場合、 $N_z = 1$ の場合よりも、同じ面内位相差を持つならば、液晶表示装置の視野角が

n_y ：フィルム面内における主延伸方向に直交する方位の屈折率

n_z ：フィルム表面の法線方向の屈折率

とする。ここで、主延伸方向とは一軸延伸の場合には延伸方向、二軸延伸の場合にはより配向度が上がるように延伸した方向を意味しており、化学構造的には高分子主鎖の配向方向を指す。負の屈折率異方性とはこれら三次元屈折率を用いて、ここでは $n_x < n_z$ のように表される。

【0012】この三次元屈折率は、位相差フィルムに偏光を入射して得られる出射光の偏光状態を解析する手法である偏光解析法により測定されるが、本発明では位相差フィルムの光学異方性を屈折率積円体と見なして公知の屈折率積円体の式により求める方法によりこの三次元屈折率を求めている。なお、特に断りが無い限り測定波長は550nmとした。

【0013】このような負の屈折率異方性を有する位相差フィルムを正の屈折率異方性を有する位相差フィルムと組み合わせることにより、正の屈折率異方性を有する位相差フィルムの視野角特性を改善することができる。ここで言う正の屈折率異方性とは先述した三次元屈折率を用いて $n_x > n_z$ で表される。先述したように正の屈折率異方性を有する位相差フィルムは、膜厚方向に屈折率が大きくなるような特殊な延伸方法を取らない限り $n_z > n_x$ にならないが、その代わりに $n_x < n_z$ である負の屈折率異方性を有する位相差フィルムと積層することにより、実質的に n_z を面内の屈折率 n_x 、 n_y のいずれかまたは両方よりも大きくすることが可能となる。

【0014】ここで該積層位相差フィルム(積層体ということがある)の n_z が実質的に面内の屈折率 n_x 、 n_y のいずれかまたは両方よりも大きくなったかどうかは、先述の偏光解析法で該積層体を屈折率積円体と見なして測定することにより評価することができる。

【0015】位相差フィルムの三次元屈折率を用いて光学異方性を表記する方法として下記式(6)

【0016】

【数4】

改善されるといった効果が知られている。

【0017】また、本発明の如く正と負の屈折率異方性を有する位相差フィルムがいずれもポリカーボネートからなる場合には、各々のフィルムが熱的耐久性に優れるとともに、類似高分子材料からなるために粘着剤の選定も容易であって、かつ積層体の耐久性も向上させることが可能である。

【0018】

【発明の実施の形態】本発明は、測定波長550nmで測定した三次元屈折率が、下記式(1)を満足するポリカーボネートからなる負の屈折率異方性を有する位相差フィルムと、下記式(2)を満足するポリカーボネート

からなる正の屈折率異方性を有する位相差フィルムの、それぞれ少なくとも1枚以上からなる積層体からなることを特徴としている。

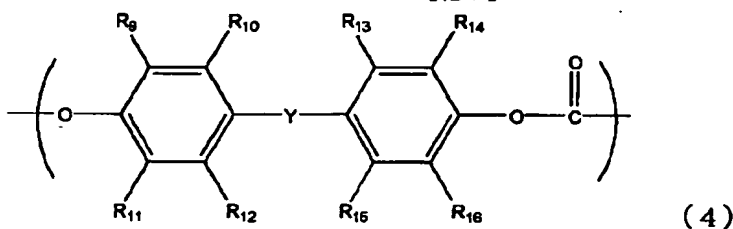
【0019】

【数5】 $n_x < n_z$ (1)

$n_x > n_z$ (2)

測定波長としては好ましくは450、550、650nmのいずれの波長でも上記式(1)、(2)が成り立つことである。上記式(1)を満足するポリカーボネートとしては、例えば下記式(3)

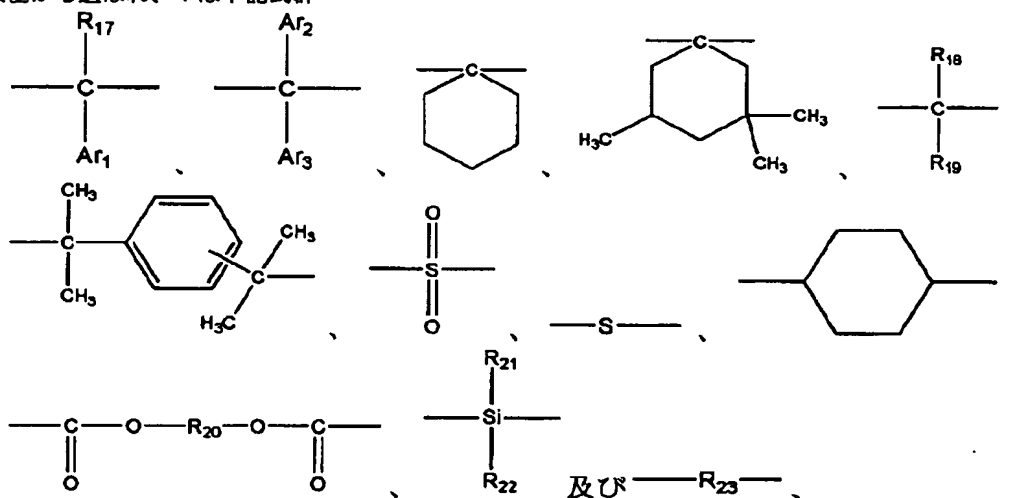
【0020】



【0023】(上記式(4))において、R9～R16はそれぞれ独立に水素原子、ハロゲン原子及び炭素数1～3の炭化水素基から選ばれ、Yは下記式群

【0024】

【化9】

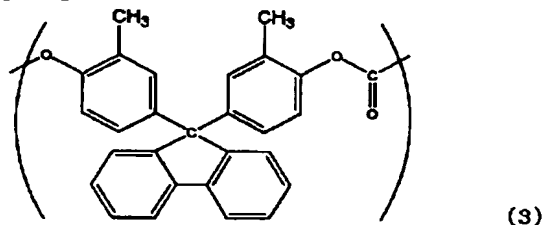


【0025】(上記式群中、R17～R19、R21、R22はそれぞれ独立に水素原子、ハロゲン原子及び炭素数1～22の炭化水素基から選ばれ、R20及びR23はそれぞれ独立に炭素数1～20の炭化水素基から選ばれ、また、Ar1～Ar3はそれぞれ独立に炭素数6～10のアリール基から選ばれ、)で示される繰り返し単位とからなるポリカーボネートを挙げることができる。

【0026】上記式(3)は、メチル基を有するフルオレン骨格を持つ繰り返し単位である。

【0027】上記式(4)中、R9～R16は、それぞれ独立に水素原子、ハロゲン原子及び炭素数1～3の炭化水素基から選ばれる少なくとも一種である。ハロゲン原子としては、フッ素、塩素、臭素、ヨウ素を挙げることができる。炭素数1～3の炭化水素基としては、メチル

【化7】



【0021】で示される繰り返し単位と、下記式(4)

【0022】

【化8】

基、エチル基、n-プロピル基、イソプロピル基等のアルキル基等を挙げることができる。このなかでR9～R16は全て水素原子が好ましい。Yは上記式群から選ばれ、上記式群中、R17～R19、R21及びR22はそれぞれ独立に水素原子、ハロゲン原子及び炭素数1～22の炭化水素基から選ばれる少なくとも一種である。ハロゲン原子としては前記したものと同じものを挙げることができる。炭素数1～22の炭化水素基としては、メチル基、エチル基、n-プロピル基、イソプロピル基、ブチル基、ペンチル基、シクロヘキシル基等の炭素数1～22の(シクロ)アルキル基、フェニル基、ビフェニル基、ターフェニル基、ナフチル等の炭素数6～18のアリール基を挙げることができる。

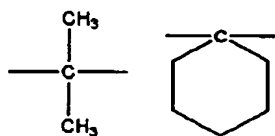
【0028】R20及びR23はそれぞれ独立に炭素数1～

20の炭化水素基から選ばれる少なくとも一種である、かかる炭化水素基としては、エチレン基等の炭素数2～20の2価の(シクロ)アルキレン基、フェニル基、ビフェニル基、ターフェニル基、ナフチル基等の炭素数6～18の2価のアリーレン基を挙げることができる。

【0029】また、Ar₁～Ar₃はそれぞれ独立に、フェニル基、ナフチル基等の炭素数6～10のアリール基を挙げることができる。

【0030】上記ポリカーボネートは、より好ましくは、上記式(3)で示される繰り返し単位と、下記式(5)

【0031】



【0034】で示される繰り返し単位とから構成されるものである。

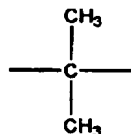
【0035】上記式(3)で表される繰り返し単位は該ポリカーボネート全体、すなわち上記式(3)及び

(4)で表わされる繰り返し単位の合計に基づきの71～98モル%を占め、上記式(4)で表される繰り返し単位は29～2モル%を占めるポリカーボネートからなることが好ましい。上記式(3)の繰り返し単位はそれ単独重合体でも負の屈折率異方性を有するが、これが上記範囲より多すぎる場合には重合が困難であるため生産性が劣ったり、また成形性が悪くなるといった問題がある。また、上記範囲より繰り返し単位(3)が少ない場合には、負の屈折率異方性をとることが困難な場合がある。上記式(3)で表される繰り返し単位は該ポリカーボネート全体の72～96モル%を占め、上記式(4)(好ましくは(5))で表される繰り返し単位は28～4モル%を占めるポリカーボネートからなるものである。さらに好ましくは上記式(3)で表される繰り返し単位は該ポリカーボネート全体の73～94モル%を占め、上記式(4)(好ましくは(5))で表される繰り返し単位は27～6モル%を占めるポリカーボネートからなるものである。

【0036】最も好ましくは、上記式(1)で表される繰り返し単位と、上記式(2)(ただし、Zは下記式

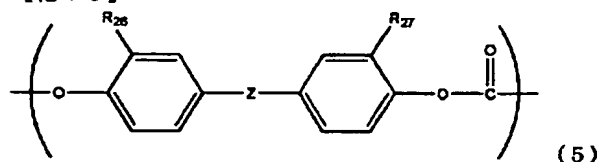
【0037】

【化12】



【0038】である)で表わされる繰り返し単位からな

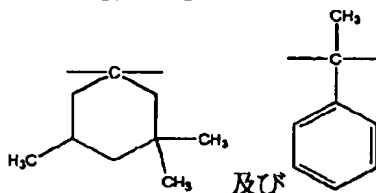
【化10】



【0032】(上記式(5)においてR₂₆及びR₂₇はそれぞれ独立に水素原子及びメチル基から選ばれる少なくとも一種であり、Zは下記式群

【0033】

【化11】



り、上記式(1)で表される繰り返し単位は、該ポリカーボネート全体の76～90モル%を占め、上記式

(2)で表される繰り返し単位は24～10モル%を占めるものである。

【0039】上記正及び負の位相差フィルムは、それぞれが共重合体、単独重合体同士のブレンド、共重合体同士のブレンド、単独重合体と共重合体とのブレンドのいずれであってもよく、負の屈折率異方性の場合には上記繰り返し単位の範囲を満足していれば良い。上記繰り返し単位を満足しているかどうかはH-NMR等により分析される。

【0040】上記ポリカーボネートは共重合、特にジヒドロキシ化合物とホスゲンとの界面重合において、例えば、2種類以上の繰り返し単位からなるものを作製しようとした場合、モノマー仕込み量を変えるだけでそれらの共重合比を任意にしかも簡単に制御できるといった利点がある。一方、ポリエステルやポリアリレートの場合には、ジヒドロキシ化合物とジカルボン酸を等量ずつ重合しなくてはならないといった光学特性を制御する上で不利な点がある。負の屈折率異方性を有しつつ、耐熱性や成形性を満足させた位相差フィルムを作製するには、前述したようにある特定の繰り返し単位がある割合で入っている必要があり、そのような分子設計上の観点からもポリカーボネートは有用である。

【0041】なお、高分子材料の屈折率異方性はそのほとんどが化学構造により決定されるが、延伸法や製膜法によってもある程度は変化させ得る。

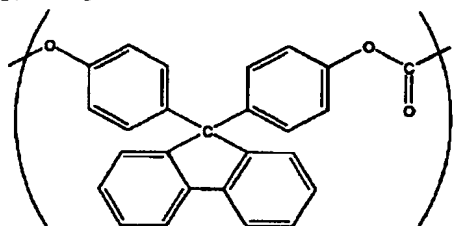
【0042】上記ポリカーボネートの分子量としては、メチレンクロライドを溶媒とした極限粘度測定により規定されるが、20℃における極限粘度が0.30～2.0dl/gであることが好ましい。

【0043】上記式(3)と類似構造のものに、フルオ

レン骨格を有する下記式(7)があるが、この繰り返し単位が多いと、上記式(3)を用いた場合より剛直なためガラス転移点温度が高くなってしまい、さらに成形性が不十分となることがある。

【0044】

【化13】

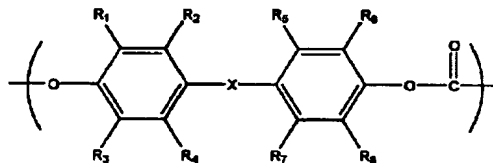


(7)

【0045】上記負の屈折率異方性を有する位相差フィルムは、波長400～700nmにおいて通常短波長ほど位相差値 R ($R = \Delta n \cdot d = (n_x - n_y) \cdot d$ 、 d はフィルムの膜厚(nm))が大きい波長分散性を示す。

【0046】本発明によれば、上記負の屈折率異方性を有する位相差フィルムと正の屈折率異方性を有する位相差フィルムとを積層することにより、正の屈折率異方性を有する位相差フィルム単独では容易に到達できない、 n_z が n_x 、 n_y の少なくともいずれかより大きい特性を有するフィルムとほぼ同等の光学特性を得ることができる。

【0047】上記式(2)を満たす正の屈折率異方性を有する位相差フィルムの材料としてはポリカーボネートであれば特に限定はない。上記式(4)の繰り返し単位

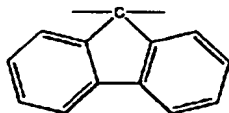


(8)

【0052】(上記式(8)において、 $R_1 \sim R_8$ はそれぞれ独立に水素原子、ハロゲン原子及び炭素数1～6の炭化水素基から選ばれ、 X は

【0053】

【化15】



【0054】である。)で示される繰り返し単位と、下記式(4)

【0055】

を有するもの等が好適に用いられる。もちろん、共重合やブレンドであってもよい。

【0048】また、正の屈折率異方性を有する位相差フィルムの測定波長450、550nmにおける位相差値 $R(450)$ 、 $R(550)$ の関係が、下記式(6)で表されるものと負の屈折率異方性を有するポリカーボネート位相差フィルムを積層させることにより、例えば、広帯域で位相差が四分の一波長となりかつ膜厚方向の屈折率も制御された位相差フィルムを提供できる。これは特に偏光板一枚使用の反射型液晶表示装置に用いられる位相差フィルムとして有用である。

【0049】

【数6】

$$R(450)/R(550) < 1 \quad (5)$$

四分の一波長板の位相差は人間の視感度の高い測定波長550nmで四分の一波長であることが好ましく、 $R(550)$ では90～180nm、より好ましくは110～170nmである。

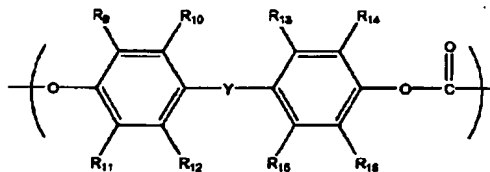
【0050】上記式(6)を満足する正の屈折率異方性を有する位相差フィルムとしてはポリカーボネートであれば特に限定はなく、例えばビスフェノールAをビスフェノール成分とするポリカーボネート、フルオレン骨格を有するポリカーボネート等が挙げられる。フルオレン骨格を有するこのポリカーボネートは例えば、下記式

(8)

【0051】

【化14】

【化16】

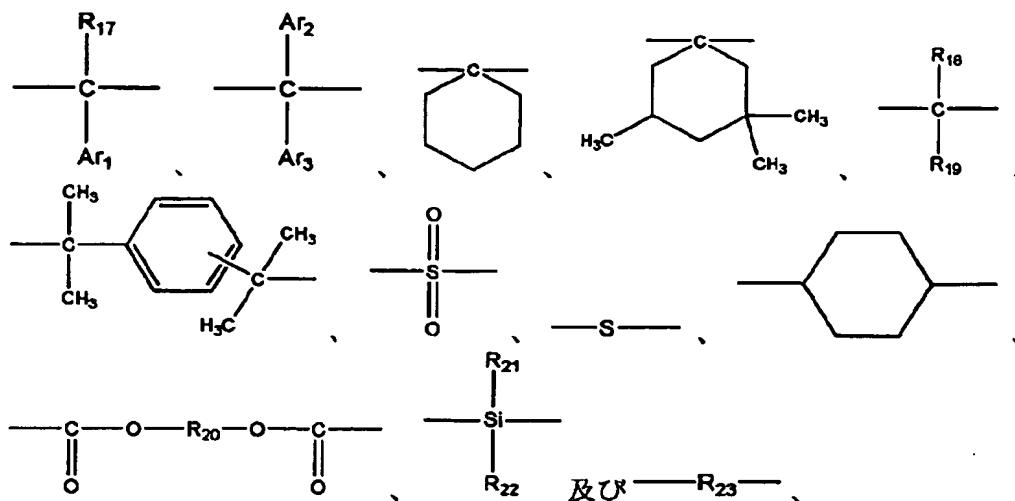


(4)

【0056】(上記式(4)において、 $R_9 \sim R_{16}$ はそれぞれ独立に水素原子、ハロゲン原子及び炭素数1～3の炭化水素基から選ばれ、 Y は下記式群

【0057】

【化17】



【0058】（定義は前記したものと同様である）で示される繰り返し単位とからなり、かつ上記式（8）で表される繰り返し単位は該ポリカーボネート全体の40～71モル%を占め、上記式（4）で表される繰り返し単位は60～29モル%を占めるポリカーボネートからなるもの等が挙げられる。もちろんこれに限定されるものではない。

【0059】本発明におけるポリカーボネートの製造方法としては、ジヒドロキシ化合物とホスゲンとの界面重合、熔融重合法等が好適に用いられる。

【0060】ブレンドする場合は、相溶ブレンドが好ましいが、完全に相溶しなくても成分間の屈折率を合わせれば成分間の光散乱を抑え、透明性を向上させることが可能である。2種類以上のポリカーボネートをブレンドする場合は、相溶ブレンドが好ましいが、完全に相溶しなくても成分間の屈折率を合わせれば成分間の光散乱を抑え、透明性を向上させることが可能である。得られたブレンド体は、ヘイズ値が3%以下であることが好ましい。

【0061】本発明の積層位相差フィルムにおいては、屈折率異方性が負の位相差フィルムと、正の屈折率異方性を有する位相差フィルムとをそれぞれ面内の屈折率最大方位を直交させて積層してもよい。この構成は、例えば、正、負いずれの屈折率異方性を有する位相差フィルムも縦一軸延伸して作製することを考えた場合、両方の延伸方向を合わせて積層させた場合に相当する。なぜならば、正の屈折率異方性を有する位相差フィルムは n_x が面内の屈折率最大方位でかつ延伸方向であり、一方、負の屈折率異方性を有する位相差フィルムでは n_y が面内の屈折率最大方位で延伸方向に直交するからである。すなわちこの構成ではロールツウロール工程で延伸方向である長手方向を合わせるので、該2種類の位相差フィルムを貼り合わせる工程においてロールツウロールで積層体を作製することができるという利点がある。

【0062】本発明における屈折率異方性が負の位相差

フィルムにおいて $n_x \approx n_y$ の場合には、正の屈折率異方性を有する位相差フィルムとの積層角度は特に限定はない。 $n_x \approx n_y$ の場合とは測定波長550nmにおける位相差値が20nm以下の場合である。

【0063】本発明における位相差フィルムの位相差波長分散は、通常位相差フィルム表面に垂直入射して測定した場合と、斜め入射した場合で通常ほぼ同じであるが、本発明の正と負の屈折率異方性を有する位相差フィルムの積層体は、それら両者を大きく違ったものにするのが可能であり、液晶表示装置等の用途に応じて様々な種類の位相差波長分散を有する位相差フィルムを供給することが可能である。ここで言う位相差波長分散とは測定波長400～700nmにおいて測定した位相差値の変化の度合いを指す。例えば測定波長450、550nmにおける位相差値である $R(450)$ 、 $R(550)$ との比である $R(450)/R(550)$ 等である。

【0064】本発明の位相差フィルムは、前記したような高分子材料からなるフィルムを製膜、または製膜後に延伸した後、積層することにより製造することができる。フィルム製膜法としては公知の熔融押し出し法、溶液キャスト法等が用いられるが、膜厚むら、外観等の観点から溶液キャスト法がより好ましく用いられる。溶液キャスト法における溶剤としては、メチレンクロライド、ジオキソラン等が好適に用いられる。

【0065】また、延伸方法も公知の縦一軸、横一軸、二軸延伸等の延伸方法を使用し得る。延伸性を向上させる目的で、延伸前のフィルム中に、公知の可塑剤であるジメチルフタレート、ジエチルフタレート、ジブチルフタレート等のフタル酸エステル、トリブチルフォスフェート等のりん酸エステル、脂肪族二塩基エステル、グリセリン誘導体、グリコール誘導体等を配合することができる。先述のフィルム製膜時に用いた有機溶剤をフィルム中に残留させ延伸しても良い。この有機溶剤の量としてはポリマー固形分対比1～20重量%であることが好

ましい。

【0066】位相差フィルム作製の延伸条件としてはガラス転移点温度の -30°C から $+50^{\circ}\text{C}$ の範囲で行うことが好ましい。このガラス転移点温度は例えば溶剤等の添加物が含まれている場合にはそれらを含んだ状態でのガラス転移点温度を指すものとする。好ましくはガラス転移点温度の -10°C から $+20^{\circ}\text{C}$ の範囲である。また、 $n_x \approx n_y$ である位相差フィルムを作製する場合には、製膜工程のみでいわゆる一般の一軸、二軸延伸工程が不要な場合もある。

【0067】さらに、位相差フィルム中にはフェニルサリチル酸、2-ヒドロキシベンゾフェノン、トリフェニルフォスフェート等の紫外線吸収剤や、色味を変えるためのブルーイング剤、酸化防止剤等を添加してもよい。

【0068】前記の添加物の量としては高分子材料対比10重量%以下であることが好ましい。これら添加物が光学的に異方性を有している場合には、位相差フィルムのリタデーションに影響を与える場合があるが、本発明では高分子材料だけで十分な光学異方性を発現させることが可能である。

【0069】上記（積層）位相差フィルムの膜厚としては、特に制限はないが、通常 $1\mu\text{m}$ から $400\mu\text{m}$ 、好ましくは $30\sim 200\mu\text{m}$ である。

【0070】本発明の（積層）位相差フィルムは透明であることが好ましく、ヘーズ値は3%以下、全光線透過率は85%以上であることが好ましい。さらに、無色透明であることが好ましく、JIS Z-8729記載の $L^*a^*b^*$ 表色系のうち、2度視野、C光源を用いた測定で b^* が1.2以下、より好ましくは1以下である。

【0071】本発明の積層位相差フィルムは、例えば、通常のヨウ素や染料等の二色性吸収物質を含有する偏光フィルムや、誘電体多層膜やコレステリック高分子液晶からなる片側の偏光だけを反射または散乱させるような反射型偏光板等と貼り合せ位相差フィルム一体型偏光フィルムとしてもよい。この場合には偏光フィルムの視角特性も改善することが可能である。

【0072】位相差フィルム、偏光フィルム、液晶表示装置への実装は粘着剤が必要だが、粘着剤としては公知のものが用いられる。粘着剤の屈折率は積層するフィルムの屈折率の中間のものが、界面反射を抑える点で好ましい。

【0073】上述した積層位相差フィルムや位相差フィルム一体型偏光フィルムを液晶表示装置等に使用することにより画質の向上が実現可能である。また、ガラス基板の代わりに本発明の位相差フィルムを使用しても良い。この場合、液晶表示装置の光学部材を減らすことが出来る上、ガラス基板の欠点である厚みを薄く出来るので、特に反射型液晶表示装置で問題となるガラスの厚みに起因する視差による画像のぼけを防ぐことが可能であるし、ガラス基板の割れ易さを補うことができるという

た効果を有する。

【0074】また、本発明の積層位相差フィルムは、正の屈折率異方性を有する位相差フィルムと、負の屈折率異方性を有する位相差フィルムとが粘着剤を介するなどして接して積層されているが、間に他の光学部材が入っていても良い。光学部材としては例えば前方散乱フィルム等を設置しても良い。それら使用形態は用途に応じて決定される。

【0075】本発明の積層位相差フィルムの構成例を図2～5に示すがこれらに限定されるものではない。また、積層位相差フィルムの構成する上記正、負の位相差フィルムは単独（1枚）で用いることができるが、2枚以上使用しても良い。

【0076】本発明の負の位相差フィルムを液晶表示装置に用いた具体例を図6、7に示す。

【0077】図6は積層位相差フィルムが使用された反射型液晶表示装置の例を示しており、構成は、偏光フィルム5//ポリカーボネート積層位相差フィルム（四分の一波長板）4//ガラス基板7//透明電極8//液晶層9//凹凸反射電極10//ガラス基板11である。

【0078】図7は負の屈折率異方性を有する位相差フィルムが使用されたスーパーツイストネマチック半透過反射型液晶表示装置の例を示しており、構成は、偏光フィルム12//前方散乱フィルム13//負の屈折率異方性を有する位相差フィルム3//正の屈折率異方性を有する位相差フィルム1//ガラス基板15//透明電極16//液晶層17//半透過反射電極18//ガラス基板19//正の屈折率異方性を有する位相差フィルム1//偏光フィルム21である。なお、偏光フィルムの下にあるバックライトシステムは省略した。

【0079】なお、図2～7では2は粘着層である。また、液晶用配向膜、薄膜トランジスタ、カラーフィルタ等は省略してあるが設置しても良い。

【0080】

【実施例】以下に実施例を挙げて本発明をより詳細に説明するが、本発明はこれらに限定されるものではない。

【0081】（評価法）本明細書中に記載の材料特性値等は以下の評価法によって得られたものである。

【0082】（1）位相差R、K、三次元屈折率（ n_x , n_y , n_z ）、 N_z の測定
複屈折 Δn と膜厚 d の積である位相差R値、K値、三次元屈折率、 N_z は、偏光解析法を位相差測定手段にしている日本分光（株）製の「M150」により測定したものである。R値は入射光線とフィルム表面が直交する状態で測定しており、 $R = \Delta n \cdot d = (n_x - n_y) \cdot d$ である。また、K値は入射光線とフィルム表面の角度を変えることにより、各角度での位相差値を測定し、公知の屈折率楕円体の式でカーブフィッティングすることにより三次元屈折率である n_x , n_y , n_z を求め、 $K = (n_z - (n_x + n_y) / 2) \cdot d$ に代入することによ

り求めている。なお、その際、別のパラメータとして平均屈折率 $n = (n_x + n_y + n_z) / 3$ が必要になるが、平均屈折率 n については分光光源がついたアッペ屈折率計である(株)アタゴ社製の「アッペ屈折計2-T」を用いた。また、正と負の屈折率異方性を有する位相差フィルムの積層体の場合にも、同様に屈折率積円体と仮定して評価した。この積層体の場合には、平均屈折率は積層する各フィルムの平均屈折率の平均を取るものとし、また、膜厚は各フィルムの膜厚の和とした。

【0083】屈折率積円体の式とは、以下の式を用いた。なお、以下の式では、 d は膜厚(nm)、 θ はフィルム表面法線方向と入射光線とのなす角である。

【0084】

【数7】

$$R(\theta) = \Delta n(\theta) \cdot d / (1 - \sin^2 \theta / n^2) 0.5$$

【0085】(a)回転軸が進相軸の場合

$$\text{【数8】 } \Delta n(\theta) = n_x \cdot n_z / [(n_x^2 - n_z^2) \sin^2 \theta / n^2 + n^2] 0.5 - n_y$$

【0086】(b)回転軸が遅相軸の場合

【数9】

$$\Delta n(\theta) = n_x - n_y \cdot n_z / [(n_y^2 - n_z^2) \sin^2 \theta / n^2 + n^2] 0.5$$

【0087】(2)全光線透過率及びヘーズの測定

日本工業規格JIS K 7105「プラスチックの光学的特性試験方法」に準じ積分球式透過率測定装置により測定した。評価装置としては、日本電色工業(株)製の色差・濁度測定器(「COH-300A」)を用いた。

【0088】(3)高分子共重合比の測定

日本電子社製の「JNM-alpha600」のプロトンNMRにより測定した。特にビスフェノールAとビスクレゾールフルオレンの共重合体の場合には、溶媒として重ベンゼンを用い、それぞれのメチル基のプロトン強度比から算出した。

【0089】(4)高分子のガラス転移点温度(T_g)の測定

TA Instruments社製の「DSC2920 Modulated DSC」により測定した。フィルム成形後ではなく、樹脂重合後、フレイクスまたはチップの状態にて測定した。

【0090】(5)高分子の極限粘度測定

ウペローデ粘度管を用い、メチレンクロライド中20℃で極限粘度を求めた。

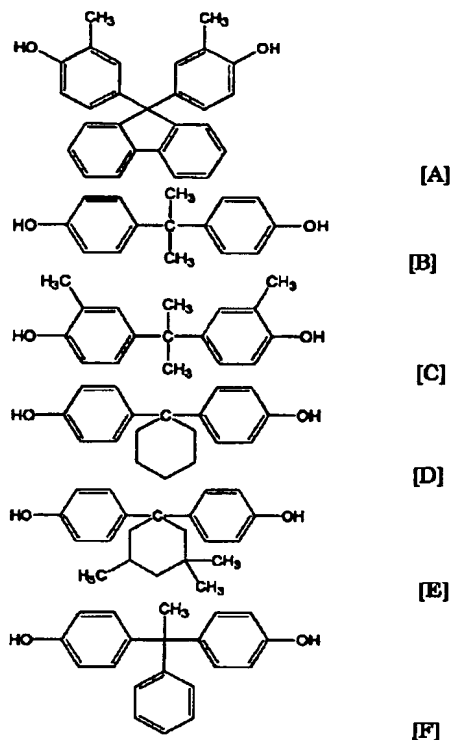
【0091】(6)フィルム膜厚測定

アンリツ社製の電子マイクロで測定した。

【0092】また、以下の実施例、比較例で用いたポリカーボネートのモノマー構造を以下に記す。ポリマーの分析はプロトンNMR法を用いて行った。

【0093】

【化18】



【0094】【参考例1】攪拌機、温度計及び還流冷却器を備えた反応槽に水酸化ナトリウム水溶液及びイオン交換水を仕込み、これに上記構造を有するモノマー[A]と[B]を表1のモル比で溶解させ、少量のハイドロサルファイトを加えた。次にこれに塩化メチレンを加え、20℃でホスゲンを経過させて吹き込んだ。さらに、p-tert-ブチルフェノールを加えて乳化させた後、トリエチルアミンを加えて30℃で約3時間攪拌して反応を終了させた。反応終了後有機相分取し、塩化メチレンを蒸発させてポリカーボネート共重合体を得た。得られた共重合体の組成比はモノマー仕込み量比とほぼ同様であった。この共重合体をメチレンクロライドに溶解させ、固形分濃度19重量%のドープ溶液を作製した。このドープ溶液からキャストフィルムを作製し、寸法を固定させた状態で乾燥させることにより位相差フィルムを作製した。このフィルムの特性を表1に記す。

【0095】【参考例2】表1記載のモノマーを使った以外は参考例1と同様の方法にてポリカーボネート共重合体を得た。得られた共重合体の組成比はモノマー仕込み量比とほぼ同様であった。実施例1と同様に位相差フィルムを作製した。

【0096】【参考例3】表1記載のモノマーを使った以外は参考例1と同様の方法にてポリカーボネート共重合体を得た。得られた共重合体の組成比はモノマー仕込み量比とほぼ同様であった。この共重合体をメチレンクロライドに溶解させ、固形分濃度19重量%のドープ溶液を作製した。このドープ溶液からキャストフィルムを作製し、乾燥後、一軸延伸機により温度241℃倍率

1. 3倍に一軸延伸し位相差フィルムを得た。結果を表1に記す。

【0097】【参考例4】表1記載のモノマーを使った以外は参考例1と同様の方法にてポリカーボネート共重合体を得た。得られた共重合体の組成比はモノマー仕込み量比とほぼ同様であった。この共重合体をメチレンクロライドに溶解させ、固形分濃度20重量%のドープ溶液を作製した。このドープ溶液からキャストフィルムを作製し、寸法を固定させた状態で乾燥させることにより位相差フィルムを作製した。このフィルムの特性を表1に記す。

【0098】【参考例5】表1記載のモノマーを使った以外は参考例1と同様の方法にてポリカーボネート共重合体を得た。得られた共重合体の組成比はモノマー仕込み量比とほぼ同様であった。この共重合体をメチレンクロライドに溶解させ、固形分濃度20重量%のドープ溶液を作製した。このドープ溶液からキャストフィルムを作製し、乾燥後、一軸延伸機により温度241℃倍率

1. 2倍に一軸延伸し位相差フィルムを得た。結果を表1に記す。

【0099】【参考例6】表1記載のモノマーを使った以外は参考例1と同様の方法にてポリカーボネート共重合体を得た。得られた共重合体の組成比はモノマー仕込み量比とほぼ同様であった。この共重合体をメチレンクロライドに溶解させ、固形分濃度20重量%のドープ溶液を作製した。このドープ溶液からキャストフィルムを作製し、寸法を固定させた状態で乾燥させることにより位相差フィルムを作製した。このフィルムの特性を表1に記す。

【0100】【参考例7】表1記載のモノマーを使った以外は参考例1と同様の方法にてポリカーボネート共重合体を得た。得られた共重合体の組成比はモノマー仕込み量比とほぼ同様であった。この共重合体をメチレンクロライドに溶解させ、固形分濃度20重量%のドープ溶液を作製した。このドープ溶液からキャストフィルムを作製し、乾燥後、一軸延伸機により温度245℃倍率

1. 7倍に一軸延伸し位相差フィルムを得た。結果を表1に記す。

【0101】

【表1】

	参考例 1	参考例 2	参考例 3	参考例 4	参考例 5	参考例 6	参考例 7
モノマー1構造 (仕込み量モル%)	[A] (81)	[A] (86)	[A] (81)	[A] (81)	[A] (75)	[A] (74)	[A] (80)
モノマー2構造 (仕込み量モル%)	[B] (19)	[B] (14)	[B] (19)	[C] (19)	[D] (25)	[E] (26)	[F] (20)
構成等その他							
T _g (°C)	242	248	242	233	241	243	245
極限粘度[η]	0.807	0.813	0.807	0.871	0.776	0.351	0.686
R(550) (nm)	-2.6	-2.7	-75.2	-7.2	-44.5	-8.6	-118.5
K(550) (nm)	82.8	82.5	48.2	41.4	22.4	34.7	58.8
平均屈折率n(550)	1.628	1.628	1.628	1.621	1.623	1.615	1.628
n _x	1.62562	1.62581	1.62517	1.62111	1.62293	1.61509	1.62672
n _y	1.62564	1.62584	1.62549	1.62119	1.62333	1.61515	1.62927
n _z	1.62644	1.62665	1.62664	1.62100	1.62333	1.61537	1.62921
N _z	28.0	32.5	1.1	6.1	1.0	4.7	1.0
全光線透過率(%)	80.1	80.2	90.3	90.0	80.0	80.6	90.1
ヘーズ(%)	0.5	0.2	0.4	0.4	0.4	0.5	0.6
膜厚(μm)	161.8	100.0	57.0	92.0	112.0	138.8	48.8

【0102】【実施例1】表1記載のモノマーを使った以外は参考例1と同様の方法にてポリカーボネートホモ重合体を得た。このホモ重合体をメチレンクロライドに溶解させ、固形分濃度20重量%のドープ溶液を作製した。このドープ溶液からキャストフィルムを作製し、乾燥後、一軸延伸機により温度161℃倍率1. 1倍に一軸延伸し位相差フィルムを得た。結果を表1に記す。

【0103】さらに、このフィルムと参考例1で作製した位相差フィルムとを延伸方向を合わせて粘着層を介して貼り合せた。その積層体(積層位相差フィルム)の特性を表1に記す。なお、位相差測定に際しては参考例1で作製したフィルム側から光を入射した。

【0104】また、図1には上記ポリカーボネートホモ重合体からなる位相差フィルム、及び上記積層体の選相

軸を回転軸としてサンプルを回転させ、入射角度θを変えて位相差を測定した際の位相差角度依存性を記す。ポリカーボネートホモ重合体からなる位相差フィルムは入射角度を変えると位相差が変化してしまうが、N_z=0.5であるこの積層体は入射角度によらず位相差が一定であることが確認でき、視野角特性が改良されていることが分かった。

【0105】【実施例2】参考例2で作製した位相差フィルムと、実施例1で作製したモノマー[A]からなるポリカーボネートホモ重合体からなる位相差フィルムを延伸方向を合わせて、粘着剤を介して貼り合せ、積層体(積層位相差フィルム)を作製した。その積層体の特性を表2に記す。

【0106】【実施例3】表2記載のモノマーを使った

以外は参考例1と同様の方法にてポリカーボネート共重合体を得た。得られた共重合体の組成比はモノマー仕込み量比とほぼ同様であった。この共重合体をメチレンクロライドに溶解させ、固形分濃度20重量%のドープ溶液を作製した。このドープ溶液からキャストフィルムを作製し、乾燥後、一軸延伸機により温度225℃倍率2.0倍に一軸延伸し位相差フィルムを得た。結果を表2に記す。なお、本位相差フィルムの測定波長450nm、550nm、650nmにおける位相差R(450)、R(550)、R(650)の関係は

【0107】

【数10】 $R(450)/R(550)=0.77$

$R(650)/R(550)=1.08$

と短波長側ほど位相差値が小さくなるフィルムであることが分かった。

【0108】上記位相差フィルムと参考例1で作製した位相差フィルムを粘着剤を介して、延伸方向を合わせて貼り合せた。その積層体の特性を表2に記す。なお、位相差測定に際しては参考例1で作製したフィルム側から光を入射した。

【0109】【実施例4】表2記載のモノマーを使った以外は参考例1と同様の方法にてポリカーボネート共重合体を得た。得られた共重合体の組成比はモノマー仕込み量比とほぼ同様であった。この共重合体をメチレンクロライドに溶解させ、固形分濃度19重量%のドープ溶液を作製した。このドープ溶液からキャストフィルムを作製し、乾燥後、一軸延伸機により温度207℃倍率

1.2倍に一軸延伸し位相差フィルムを得た。このフィルムの特性を表2に記す。また、参考例2で作製した位相差フィルムと本フィルムを延伸方向を合わせて粘着剤を介して貼り合せた。この積層体の特性を表2に記す。なお、位相差測定に際しては参考例2で作製したフィルム側から光を入射した。

【0110】【実施例5】実施例1で作製したモノマー[A]からなるポリカーボネートホモ重合体からなる位相差フィルムと、参考例3からなる位相差フィルムを延伸方向が直交するように粘着剤を介して貼り合せた。この積層体の特性を表2に記す。

【0111】

【表2】

	実施例1		実施例2	実施例3		実施例4		実施例5
モノマー1構造 (仕込み量モル%)	[A] (100)			[A] (87)		[B] (42)		
モノマー2構造 (仕込み量モル%)	-			[B] (33)		[C] (58)		
構成等その他		積層体	積層体		積層体		積層体	積層体
T _g (°C)	180			228		205		
初期粘度[η]	0.532			0.561		0.524		
R(550) (nm)	138.8	138.2	138.2	160.4	163.4	137.4	140.5	214.1
K(550) (nm)	-83.1	0.0	0.0	-75.0	0.0	-68.6	13.0	-37.0
平均屈折率n(550)	1.588	1.607	1.607	1.628	1.628	1.570	1.598	1.607
nx	1.58847	1.60708	1.60714	1.62586	1.62586	1.57053	1.59825	1.60758
ny	1.58708	1.60654	1.60646	1.62455	1.62531	1.56900	1.59728	1.60620
nz	1.58695	1.60680	1.60680	1.62458	1.62560	1.56800	1.59788	1.60664
Nz	1.1	0.5	0.5	1.0	0.5	1.0	0.4	0.7
全光線透過率(%)	91.0	90.1	90.2	90.3	89.2	91.0	90.0	90.1
ヘーズ(%)	0.3	0.6	0.5	0.3	0.6	0.5	0.6	0.7
膜厚(μm)	100	281.9	200.0	122.0	283.9	88.5	146.6	157.0

【0112】【参考例8】参考例1と表3記載のモノマーを使った以外は同様の方法にてポリカーボネート共重合体を得た。得られた共重合体の組成比はモノマー仕込み量比とほぼ同様であった。この共重合体をメチレンクロライドに溶解させ、固形分濃度17重量%のドープ溶液を作製した。このドープ溶液からキャストフィルムを作製し、乾燥後、一軸延伸機により温度192℃倍率1.2倍に一軸延伸し位相差フィルムを得た。結果を表3に記す。わずかにnzがnyよりは大きくなっているが、Nzはほぼ1であり、実施例1で行ったような位相差の角度依存性を測定すると位相差が変化することが分かった。

【0113】【参考例9】表3記載のモノマーを使った以外は参考例1と同様の方法にてポリカーボネート共重合体を得た。得られた共重合体の組成比はモノマー仕込

み量比とほぼ同様であった。この共重合体をメチレンクロライドに溶解させ、固形分濃度20重量%のドープ溶液を作製した。このドープ溶液からキャストフィルムを作製し、乾燥後、一軸延伸機により温度232℃倍率1.2倍に一軸延伸し位相差フィルムを得た。結果を表3に記す。わずかにnzがnyよりは大きくなっているが、Nzはほぼ1であり、実施例1で行ったような位相差の角度依存性を測定すると位相差が変化することが分かった。

【0114】【参考例10】表3記載のモノマーを使った以外は参考例1と同様の方法にてポリカーボネート共重合体を得た。得られた共重合体の組成比はモノマー仕込み量比とほぼ同様であった。この共重合体をメチレンクロライドに溶解させ、固形分濃度20重量%のドープ溶液を作製した。このドープ溶液からキャストフィルム

を作製し、乾燥後、一軸延伸機により温度245℃倍率1.2倍に一軸延伸し位相差フィルムを得た。結果を表3に記す。Nzはほぼ1であり、実施例1で行ったような位相差の角度依存性を測定すると位相差が変化することが分かった。

【0115】【参考例11】表3記載のモノマーを使った以外は参考例1と同様の方法にてポリカーボネート共重合体を得た。得られた共重合体の組成比はモノマー仕込み量比とほぼ同様であった。この共重合体をメチレン

クロライドに溶解させ、固形分濃度16重量%のドープ溶液を作製した。このドープ溶液からキャストフィルムを作製し、乾燥後、一軸延伸機により温度225℃倍率1.7倍に一軸延伸し位相差フィルムを得た。結果を表3に記す。Nzはほぼ1であり、実施例1で行ったような位相差の角度依存性を測定すると位相差が変化することが分かった。

【0116】

【表3】

	参考例8	参考例9	参考例10	参考例11
モノマー1構造 (仕込み量モル%)	[A] (80)	[A] (83)	[A] (80)	[A] (45)
モノマー2構造 (仕込み量モル%)	[C] (40)	[D] (37)	[E] (40)	[F] (55)
T _g (°C)	190	232	244	225
粘度[η]	0.821	0.832	0.692	0.998
R(550) (nm)	72.8	53.9	49.9	141.8
K(550) (nm)	-34.2	-28.1	-25.1	-70.3
平均屈折率 _n (550)	1.603	1.618	1.608	1.612
n _x	1.60360	1.61840	1.60837	1.61294
n _y	1.60269	1.61780	1.60882	1.61153
n _z	1.60272	1.61781	1.60881	1.61153
N _z	1.0	1.0	1.0	1.0
全光線透過率(%)	90.5	90.7	90.8	90.2
ヘイズ(%)	0.8	0.9	0.9	0.8
膜厚(μm)	80.0	90.0	90.0	100.0

【0117】

【発明の効果】以上説明したように、本発明のポリカーボネート積層位相差フィルムは、耐熱性、成形性、光学特性等に優れており、それ単独でも液晶表示装置等光学装置において使用可能であるが、その他の位相差フィルムと組み合わせても使用可能であり、液晶表示装置等の視野角特性を改善できるといった優れた効果を有している。

【図面の簡単な説明】

【図1】実施例1における位相差フィルムの位相差入射角度依存性を示したものである。サンプルをあおる際の回転軸は遅相軸とした。縦軸は入射角0度（垂直入射）のときの位相差で規格化した位相差である。横軸は入射角θである。

【図2】本発明のポリカーボネート積層位相差フィルム

(4)（正の屈折率異方性を有する位相差フィルム(1)／／負の屈折率異方性を有する位相差フィルム(3)の積層体）である。

【図3】ポリカーボネート積層位相差フィルム(4)／／偏光フィルム(5)の積層体である。

【図4】正の屈折率異方性を有する位相差フィルム

(1)／／前方散乱フィルム(6)／／負の屈折率異方性を有する位相差フィルム(3)の積層体である。

【図5】正の屈折率異方性を有する位相差フィルム

(1)／／前方散乱フィルム(6)／／負の屈折率異方性を有する位相差フィルム(3)／／偏光フィルム(5)

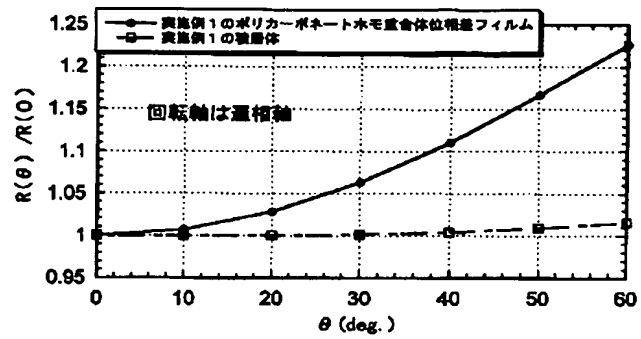
【図6】積層位相差フィルムが使用された反射型液晶表示装置の例である。

【図7】負の屈折率異方性を有する位相差フィルムが使用されたスーパーツイストネマチック半透過反射型液晶表示装置の例である。

【符号の説明】

- 1 正の屈折率異方性を有する位相差フィルム
- 2 粘着層
- 3 負の屈折率異方性を有する位相差フィルム
- 4 ポリカーボネート積層位相差フィルム
- 5 偏光フィルム
- 6 前方散乱フィルム
- 7 ガラス基板
- 8 透明電極
- 9 液晶層
- 10 凹凸反射電極
- 11 ガラス基板
- 12 偏光フィルム
- 13 前方散乱フィルム
- 15 ガラス基板
- 16 透明電極
- 17 液晶層
- 18 半透過反射電極
- 19 ガラス基板
- 21 偏光フィルム

【図1】



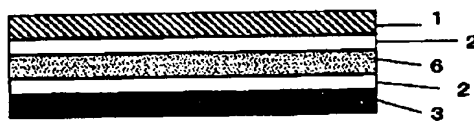
【図2】



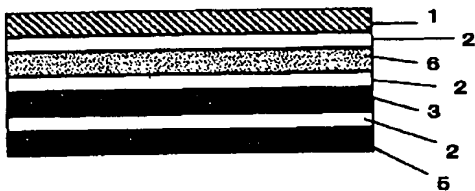
【図3】



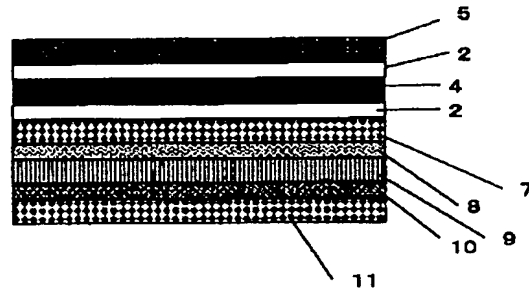
【図4】



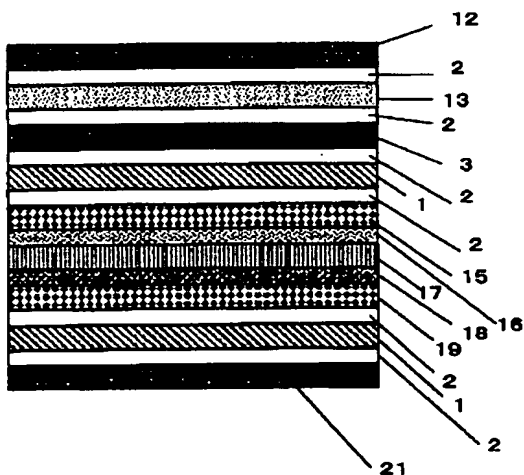
【図5】



【図6】



【図7】



フロントページの続き

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JN18B YY00A YY00B

b.

PATENT ABSTRACTS OF JAPAN

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(22)Date of filing : 13.01.2000 (72)Inventor : UCHIYAMA AKIHIKO
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TSUJIKURA SHOICHI

(54) POLYCARBONATE LAMINATED OPTICAL RETARDATION FILM

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an optical retardation film with an improved viewing angle characteristics utilizing a polycarbonate with excellent heat resistance, moldability or the like.
SOLUTION: The polycarbonate laminated optical retardation film is characterized by being a laminated body comprising an optical retardation film which has a three dimensional refractive index at 550 nm wavelength satisfying the relation 1, is composed of polycarbonate, for example one having a fluorene skeleton with a methyl group as a main constituent and has negative birefringence and an optical retardation film which has a three dimensional refractive index at 550 nm wavelength satisfying the relation 2, is composed of polycarbonate and has positive birefringence $n_x < n_z$ the relation 1 $n_x > n_z$ the relation 2 (in the relations 1, 2 n_x expresses the refractive index of the main stretching direction in the film plane and n_z expressed the refractive index in the direction normal to the film plane).

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[Patent number]
[Date of registration]

[Number of appeal against examiner's decision
of rejection]

[Date of requesting appeal against examiner's
decision of rejection]

[Date of extinction of right]

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JAPANESE [JP,2001-194668,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE
INVENTION TECHNICAL PROBLEM MEANS EXAMPLE DESCRIPTION OF DRAWINGS
DRAWINGS

[Translation done.]

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CLAIMS

[Claim(s)]

[Claim 1] The polycarbonate laminating phase contrast film characterized by consisting of a layered product of a phase contrast film which has the forward refractive-index anisotropy to which the three-dimensions refractive index in the wavelength of 550nm serves as a phase contrast film which has the negative refractive-index anisotropy which the three-dimensions refractive index in the wavelength of 550nm becomes from the polycarbonate with which are satisfied of the following type (1) from the polycarbonate with which are satisfied of the following type (2).

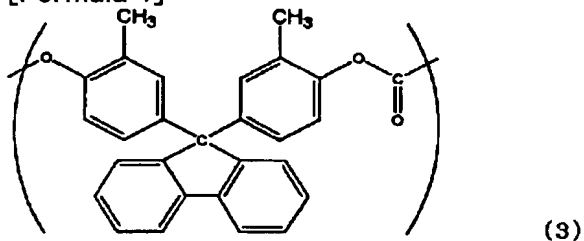
[Equation 1] $n_x < n_z$ (1)

$n_x > n_z$ (2)

(n_x is the refractive index of the main drawing direction in a film plane among the above-mentioned formula (1) and (2), and n_z is the refractive index of the direction of a normal to a film plane.)

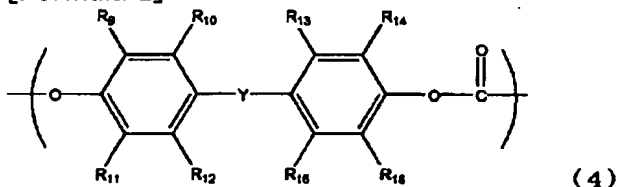
[Claim 2] The phase contrast film which has a negative refractive-index anisotropy is the following type (3).

[Formula 1]

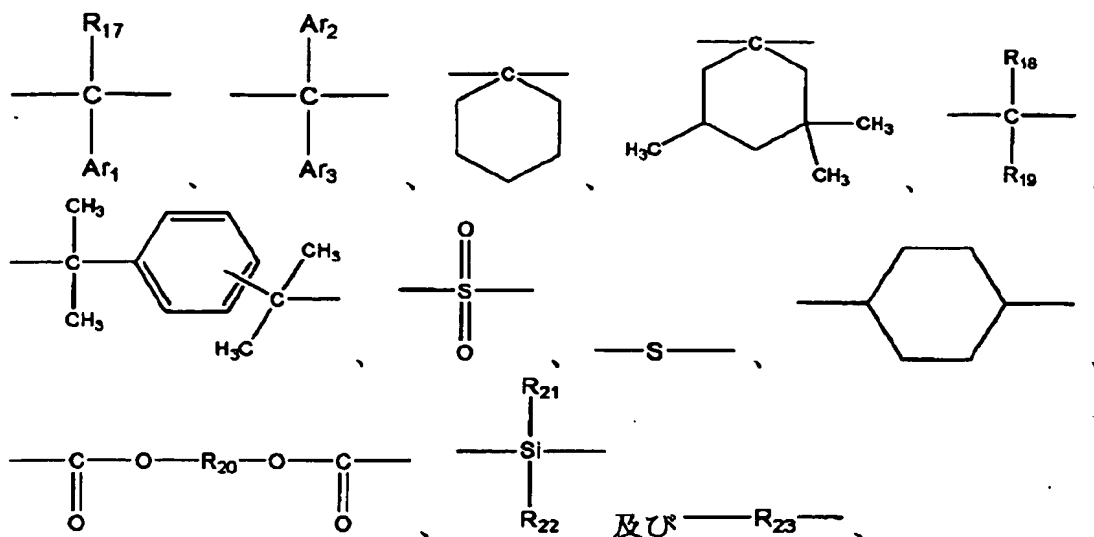


The repeat unit come out of and shown, and the following type (4)

[Formula 2]



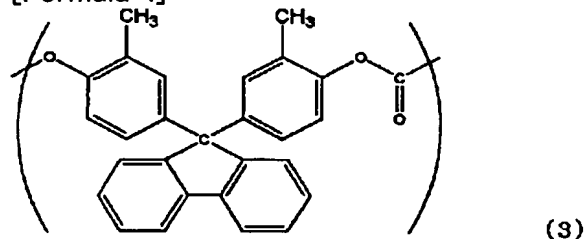
(In the above-mentioned formula (4), R9-R16 are independently chosen from the hydrocarbon group of a hydrogen atom, a halogen atom, and carbon numbers 1-3, respectively, and Y is the following formula group [** 3].)



the inside of the above-mentioned formula group, R17-R19, and R21 and R22 -- respectively -- independent -- a hydrogen atom -- it is chosen out of the hydrocarbon group of a halogen atom and carbon numbers 1-22, and R20 and R23 are independently chosen from the hydrocarbon group of carbon numbers 1-20, respectively, and Ar1-Ar3 are independently chosen from the aryl group of carbon numbers 6-10, respectively. The repeat unit which consists of a polycarbonate which consists of a repeat unit shown, and is expressed with the above-mentioned formula (3) occupies this 71 - 98-mol% of whole polycarbonate. The repeat unit expressed with the above-mentioned formula (4) is a polycarbonate laminating phase contrast film according to claim 1 characterized by occupying 29 - two-mol %.

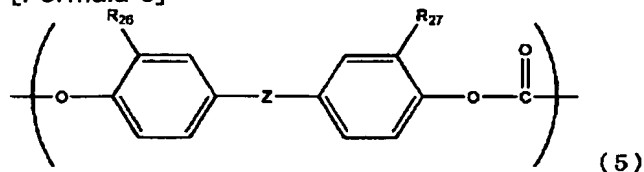
[Claim 3] The phase contrast film which has a negative refractive-index anisotropy is the following type (3).

[Formula 4]

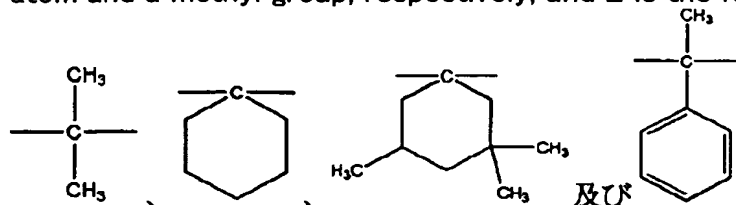


The repeat unit come out of and shown, and the following type (5)

[Formula 5]



(In the above-mentioned formula (5), R26 and R27 are independently chosen from a hydrogen atom and a methyl group, respectively, and Z is the following formula group [** 6].)



since -- it is chosen. Polycarbonate laminating phase contrast film according to claim 1 or 2 characterized by for the repeat unit which consists of POPORl carbonate which consists of repeat units shown, and is expressed with the above-mentioned formula (3) occupying this 72 - 96-mol% of whole polycarbonate, and the repeat unit formula [above-mentioned] (5) Expressed occupying 28 - four-mol %.

[Claim 4] The relation of the phase contrast values R (450) and R (550) in the measurement wavelength of 450,550nm of the phase contrast film which has a negative refractive-index anisotropy is the following type (6).

[Equation 2]

$$R(450)/R(550)<1 \quad (6)$$

The polycarbonate laminating phase contrast film according to claim 1 to 3 which comes out and is characterized by what is expressed.

[Claim 5] Claims 1-4 characterized by carrying out a laminating and becoming about the phase contrast film which has the above-mentioned negative refractive-index anisotropy, and the phase contrast film which has a forward refractive-index anisotropy so that the refractive-index maximum bearing within the field of both phase contrast films may intersect perpendicularly are, and it rubs, and is a polycarbonate laminating phase contrast film given in **.

[Claim 6] Claims 1-5 characterized by being a quarter wavelength plate are, and it rubs, and is a polycarbonate laminating phase contrast film given in **.

[Claim 7] The elliptically-polarized-light film characterized by carrying out the laminating of the polycarbonate laminating phase contrast film according to claim 1 to 6 to a polarization film.

[Claim 8] The liquid crystal display characterized by coming to use a polycarbonate laminating phase contrast film according to claim 1 to 6 and a elliptically-polarized-light film according to claim 7.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the phase contrast film by combining a phase contrast film with the negative refractive-index anisotropy which consists of a polycarbonate by which thermal resistance, a moldability, etc. were improved, and the phase contrast film which has the forward refractive-index anisotropy which consists of a polycarbonate which can control an angle-of-visibility property to arbitration according to an application. By using these phase contrast films, the liquid crystal display with which the optical property was improved can be offered.

[0002]

[Description of the Prior Art] In liquid crystal displays, such as a STN (super twisted nematic) method, the phase contrast film is used in order to solve problems, such as color compensation and angle-of-visibility amplification. Generally, as an ingredient of the phase contrast plate for color compensation, a polycarbonate, polyvinyl alcohol, polysulfone, polyether sulphone, amorphous polyolefine, etc. are used, and what stiffened a liquid crystal polymer and disco tic liquid crystal in addition to the ingredient described above as a charge of a phase contrast plate for angle-of-visibility amplification is used.

[0003] Generally, in the case of the polymeric materials which the anisotropy of the film obtained in the usual uniaxial stretching also turns into optically uniaxial, for example, have a forward refractive-index anisotropy, the phase contrast film using a thermoplastic high polymer film is difficult for the refractive index within a field to be higher than one, and to carry out only the refractive index of the direction of thickness, although the refractive-index anisotropy is made to discover according to a uniaxial-stretching process. Even if the refractive index within a field is higher than one and it cannot carry out the refractive index of the direction of thickness, there is an usable application, but when a phase contrast film performs improving the angle of visibility of a liquid crystal display, control of such a direction of thickness may be needed.

[0004] As an approach of making the refractive index of the direction of thickness high, the approach of extending in the direction of thickness, the approach of carrying out the laminating of a phase contrast film with a negative refractive-index anisotropy and the phase contrast film with a forward refractive-index anisotropy, etc. are proposed, for example.

[0005]

[Problem(s) to be Solved by the Invention] However, the approach of extending in the direction of thickness has the problem that cost will get [productivity] dramatically bad remarkably highly. Moreover, in the approach of carrying out the laminating of a phase contrast film with a negative refractive-index anisotropy, and the phase contrast film with a forward refractive-index anisotropy, the technique using that to which vertical orientation of polystyrene, polymethylmethacrylate, or the polymer liquid crystal was carried out is indicated

as a phase contrast film which has a negative refractive-index anisotropy. However, as for the film which has these negative refractive-index anisotropies, it was actual for a moldability to have needed many [a scarce thing / and] complicated orientation processings for thermal endurance like a bad polymer liquid crystal, and for there to have been problems, like the ingredient cost itself is high, and to have not appeared on the market in a commercial scene. [0006] This invention solves the above-mentioned technical problem, and thermal resistance, a moldability, etc. are to offer the phase contrast film using a good polycarbonate with which the angle-of-visibility property has been improved.

[0007]

[Means for Solving the Problem] Although this invention persons are examining widely the ingredient which has the outstanding optical property, since a phase contrast film is an optical application, in the measurement wavelength, 140 degrees C or more have observed polymeric materials, especially thermoplastic polymeric materials as glass transition point temperature as the ingredient which has 150 degrees C or more more preferably, and an advantageous ingredient in respect of a moldability from an ingredient with it, and a heat-resistant viewpoint. [there is little optical absorption and transparent]

[0008] When it had a certain specific macromolecule structure among polycarbonates, this invention persons found out that a negative refractive-index anisotropy might be made to discover, though the moldability was also good, having thermal resistance.

[0009] That is, this invention is a polycarbonate laminating phase contrast film characterized by consisting of a layered product of a phase contrast film which has the forward refractive-index anisotropy to which the three-dimensions refractive index in the wavelength of 550nm serves as a phase contrast film which has the negative refractive-index anisotropy which the three-dimensions refractive index in the wavelength of 550nm becomes from the polycarbonate with which are satisfied of the following type (1) from the polycarbonate with which are satisfied of the following type (2).

[0010]

[Equation 3] $n_x < n_z$ (1)

$n_x > n_z$ (2)

(n_x is the refractive index of the main drawing direction in a film plane among the above-mentioned formula (3), and n_z is the refractive index of the direction of a normal to a film plane.)

[0011] Although prescribed by the three-dimensions refractive index, first of all, this three-dimensions refractive index is explained to be the refractive-index anisotropy said by this invention. The refractive index n_z of bearing where a three-dimensions refractive index is expressed with n_x , n_y , and n_z , and each definition intersects perpendicularly in the main drawing direction in the refractive-index n_y :film plane of the main drawing direction in n_x :film plane: Consider as the refractive index of the direction of a normal on the front face of a film. Here, in the case of uniaxial stretching, the main drawing direction means the drawing direction and the direction extended so that the amount of preferred orientation might go up more in the case of biaxial stretching, and points out the direction of orientation of a macromolecule principal chain in chemical structure. It is expressed a negative refractive-index anisotropy like $n_x < n_z$ here using these three-dimensions refractive index.

[0012] Although this three-dimensions refractive index is measured by the polarization analysis which is the technique of analyzing the polarization condition of the outgoing radiation light obtained by carrying out incidence of the polarization to a phase contrast film, it is asking for this three-dimensions refractive index in this invention by the approach of considering that the optical anisotropy of a phase contrast film is an index ellipsoid, and searching for by the formula of a well-known index ellipsoid. In addition, measurement wavelength was set to 550nm as long as there was especially no notice.

[0013] By combining the phase contrast film which has such a negative refractive-index

anisotropy with the phase contrast film which has a forward refractive-index anisotropy, the angle-of-visibility property of a phase contrast film of having a forward refractive-index anisotropy is improvable. It is expressed with $n_x > n_z$ the forward refractive-index anisotropy said here using the three-dimensions refractive index which carried out point **. Although the phase contrast film which has a forward refractive-index anisotropy as point ** was carried out does not become $n_z > n_x$ unless the special drawing approach that a refractive index becomes large in the direction of thickness is taken instead, it becomes possible [making n_z substantially larger than both n_x and n_y within a field] by carrying out a laminating to the phase contrast film which has the negative refractive-index anisotropy which is $n_x < n_z$.

[0014] It can be evaluated by considering that this layered product is an index ellipsoid, and measuring it with the polarization analysis of point **, whether n_z of this laminating phase contrast film (it may be called a layered product) became substantially larger than both n_x and n_y within a field here.

[0015] It is the following formula (6) as an approach of writing an optical anisotropy using the three-dimensions refractive index of a phase contrast film.

[0016]

[Equation 4]

$$N_z = (n_x - n_z) / (n_x - n_y) \quad (6)$$

$N_z = 0.5$ from which a phase contrast value hardly changes even if it is $N_z \geq 1$, i.e., $n_x > n_y \geq n_z$, or $n_x \geq n_y > n_z$ by the usual approach and sees from across the film with which ***** consists of polymeric materials which have a forward refractive-index anisotropy are difficult to attain uniaxial stretching or only by carrying out biaxial stretching. Although it is required to become $n_x > n_z > n_y$ for making it $N_z = 0.5$, if it is the layered product of point **, it is possible to attain this, and it is the description that this layered product can control an optical anisotropy in $N_z < 1$. For example, rather than the case of $N_z = 1$, although based also on the optical design of a liquid crystal display, when the phase contrast film which becomes $N_z = 0.5$ is used for a liquid crystal display, if it has the same phase contrast within a field, the effectiveness that the angle of visibility of a liquid crystal display is improved is known.

[0017] Moreover, when each phase contrast film which has forward and a negative refractive-index anisotropy like this invention consists of a polycarbonate, while each film is excellent in thermal endurance, since it consists of similar polymeric materials, it is possible for selection of a binder to be also easy and for the endurance of a layered product to also raise it.

[0018]

[Embodiment of the Invention] This invention is characterized by consisting of a layered product of the phase contrast film which has the negative refractive-index anisotropy which the three-dimensions refractive index measured on the measurement wavelength of 550nm becomes from the polycarbonate with which are satisfied of the following formula (1), and the phase contrast film which has the forward refractive-index anisotropy which consists of a polycarbonate with which are satisfied of the following type (2) which consists of at least one or more sheets, respectively.

[0019]

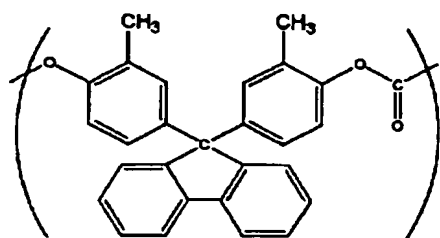
[Equation 5] $n_x < n_z$ (1)

$n_x > n_z$ (2)

It is that the above-mentioned formula (1) and (2) are realized on any [450,550,650nm] wavelength preferably as measurement wavelength. If the polycarbonate of the above-mentioned formula (1) is satisfied and carried out, it is the following type (3), for example.

[0020]

[Formula 7]

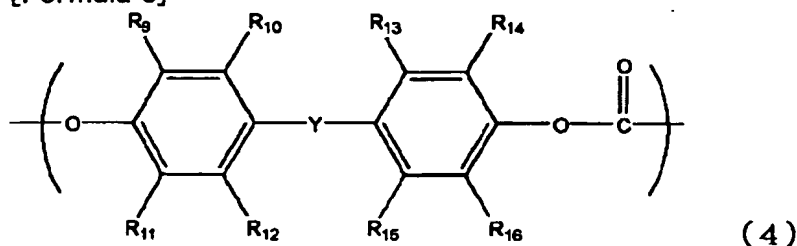


(3)

[0021] The repeat unit come out of and shown, and the following type (4)

[0022]

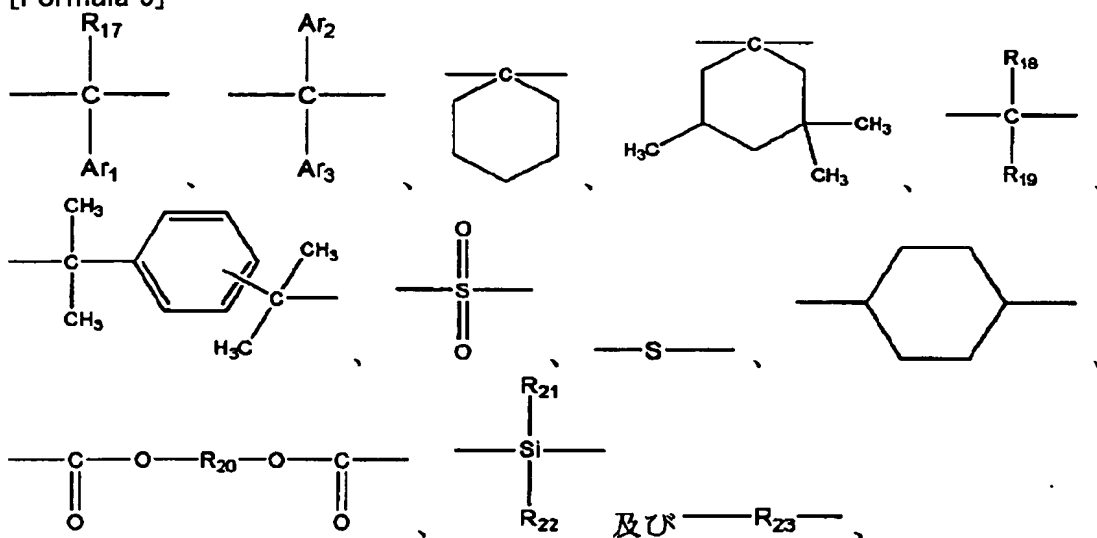
[Formula 8]



(4)

[0023] (In the above-mentioned formula (4), R9-R16 are independently chosen from the hydrocarbon group of a hydrogen atom, a halogen atom, and carbon numbers 1-3, respectively, and Y is the following formula group [0024].)

[Formula 9]



[0025] (— R17-R19, and R21 and R22 are independently chosen from the hydrocarbon group of a hydrogen atom, a halogen atom, and carbon numbers 1-22 among the above-mentioned formula group, respectively, and R20 and R23 are independently chosen from the hydrocarbon group of carbon numbers 1-20, respectively, and Ar1-Ar3 are independently chosen from the aryl group of carbon numbers 6-10, respectively.) — the polycarbonate which consists of a repeat unit shown can be mentioned.

[0026] The above-mentioned formula (3) is a repeat unit with the fluorene frame which has a methyl group.

[0027] Among the above-mentioned formula (4), as being independently chosen out of the hydrocarbon group of a hydrogen atom, a halogen atom, and carbon numbers 1-3, respectively, R9-R16 are kinds as it is few. A fluorine, chlorine, a bromine, and iodine can be mentioned as a halogen atom. As a hydrocarbon group of carbon numbers 1-3, alkyl groups, such as a methyl group, an ethyl group, n-propyl group, and an isopropyl group, etc. can be mentioned. In this, all

of R9-R16 have a desirable hydrogen atom. Y is chosen from the above-mentioned formula group. Among the above-mentioned formula group, as being independently chosen out of the hydrocarbon group of a hydrogen atom, a halogen atom, and carbon numbers 1-22, respectively, R17-R19, and R21 and R22 are kinds as it is few. The same thing as what was described above as a halogen atom can be mentioned. As a hydrocarbon group of carbon numbers 1-22, the aryl group of the carbon numbers 6-18, such as an alkyl group (cyclo) of the carbon numbers 1-22, such as a methyl group, an ethyl group, n-propyl group, an isopropyl group, butyl, a pentyl radical, and a cyclohexyl radical, a phenyl group, a biphenyl radical, a terphenyl radical, and naphthyl, can be mentioned.

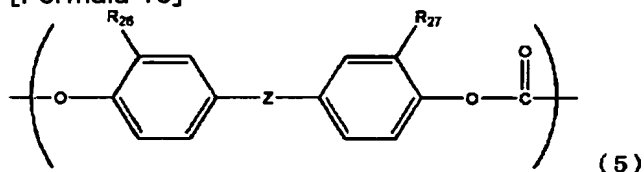
[0028] R20 and R23 can mention the divalent arylene radical of the carbon numbers 6-18, such as a divalent alkylene group (cyclo) of the carbon numbers 2-20, such as ethylene, a phenyl group, a biphenyl radical, a terphenyl radical, and a naphthyl group, as this hydrocarbon group that is independently chosen from the hydrocarbon group of carbon numbers 1-20, respectively and that is a kind at least.

[0029] Moreover, Ar1-Ar3 can mention the aryl group of the carbon numbers 6-10, such as a phenyl group and a naphthyl group, independently, respectively.

[0030] The above-mentioned polycarbonate is [the repeat unit shown by the above-mentioned formula (3), and] the following formula (5) more preferably.

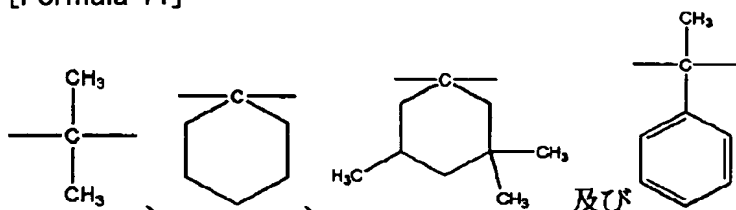
[0031]

[Formula 10]



[0032] (In the above-mentioned formula (5), R26 and R27 are independently chosen from a hydrogen atom and a methyl group, respectively. being a kind at least. Z the following formula group [0033])

[Formula 11]



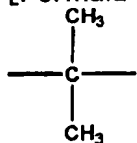
[0034] It comes out and consists of repeat units shown.

[0035] As for the repeat unit which the repeat unit expressed with the above-mentioned formula (3) occupies 71 - 98-mol % based on the sum total of the repeat unit expressed with this whole polycarbonate (3), i.e., the above-mentioned formula, and (4), and is expressed with the above-mentioned formula (4), it is desirable to consist of a polycarbonate which occupies 29 - two-mol %. Although, as for the repeat unit of the above-mentioned formula (3), its homopolymer also has a negative refractive-index anisotropy, there is a problem that productivity is inferior since the polymerization is difficult when there is too more this than the above-mentioned range, and a moldability worsens. Moreover, it may be difficult for a unit (3) to take a negative refractive-index anisotropy repeatedly, from the above-mentioned range, in being few. the repeat unit expressed with the above-mentioned formula (3) -- this 72 - 96-mol% of whole polycarbonate -- occupying -- the above-mentioned formula (4) -- (-- the repeat unit preferably expressed with (5)) consists of a polycarbonate which occupies 28 - four-mol %. the repeat unit expressed with the above-mentioned formula (3) still more preferably -- this 73 - 94-mol% of whole polycarbonate -- occupying -- the above-mentioned formula (4) -- (-- the

repeat unit preferably expressed with (5)) consists of a polycarbonate which occupies 27 – six-mol %.

[0036] It is [the repeat unit expressed with the above-mentioned formula (1) and] the above-mentioned formula (2) (however, Z the following type [0037]) most preferably.

[Formula 12]



[0038] coming out -- it is -- it consists of a repeat unit expressed, the repeat unit expressed with the above-mentioned formula (1) occupies this 76 – 90-mol% of whole polycarbonate, and the repeat unit expressed with the above-mentioned formula (2) occupies 24 – ten-mol %.

[0039] Each may be any of the blend of a copolymer and homopolymers, the blend of copolymerization, and the blend with a homopolymer and a copolymer, and, in the case of a negative refractive-index anisotropy, the above-mentioned forward and negative phase contrast film has just satisfied the range of the above-mentioned repeat unit. It is analyzed by H-NMR etc. whether the above-mentioned repeat unit is satisfied.

[0040] In copolymerization, especially the interfacial polycondensation of a dihydroxy compound and a phosgene, the above-mentioned polycarbonate has the advantage that moreover those copolymerization ratios are controllable only by changing a monomer charge simple to arbitration, when it is going to produce what consists of two or more kinds of repeat units. On the other hand, in the case of polyester or polyarylate, there is a point disadvantageous when controlling the optical property that the equivalent [every] polymerization of a dihydroxy compound and the dicarboxylic acid must be carried out. In order to produce the phase contrast film on which thermal resistance and a moldability were satisfied, having a negative refractive-index anisotropy, close needs to be at a rate which has a certain specific repeat unit as mentioned above, and the polycarbonate is useful also from a viewpoint on such a molecular design.

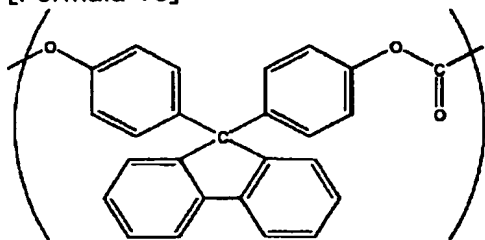
[0041] In addition, although, as for the refractive-index anisotropy of polymeric materials, the most is determined by the chemical structure, a certain extent may be changed also by the extending method or the producing-film method.

[0042] Although prescribed as molecular weight of the above-mentioned polycarbonate by the limiting viscosity measurement which used the methylene chloride as the solvent, it is desirable that the limiting viscosity in 20 degrees C is 0.30 – 2.0 dl/g.

[0043] Although there are an above-mentioned formula (3) and the following formula (7) which has a fluorene frame in the thing of similar structure, when there are many these repeat units, since it is more nearly upright than the case where the above-mentioned formula (3) is used, glass transition point temperature may become high and may become still more inadequate [a moldability].

[0044]

[Formula 13]



(7)

[0045] As for the phase contrast film which has the above-mentioned negative refractive-index anisotropy, in short wavelength, in the wavelength of 400–700nm, the phase contrast value R

($R = \Delta n \cdot d$ ($n_x - n_y$), and d and d are the thickness (nm) of a film) more nearly usually shows large wavelength dispersion nature.

[0046] the phase contrast film which has a forward refractive-index anisotropy by carrying out the laminating of the phase contrast film which has the above-mentioned negative refractive-index anisotropy, and the phase contrast film which has a forward refractive-index anisotropy according to this invention -- if independent, the optical property almost equivalent to the film with which n_z has the larger property of n_x and n_y at least than either which cannot reach easily can be obtained.

[0047] If it is a polycarbonate as an ingredient of the phase contrast film which has the forward refractive-index anisotropy with which the above-mentioned formula (2) is filled, there will be especially no definition. What has the repeat unit of the above-mentioned formula (4) is used suitably. Of course, you may be copolymerization and a blend.

[0048] Moreover, when the relation of the phase contrast values $R(450)$ and $R(550)$ in the measurement wavelength of 450,550nm of the phase contrast film which has a forward refractive-index anisotropy carries out the laminating of the polycarbonate phase contrast film which has a negative refractive-index anisotropy to what is expressed with the following formula (6), the phase contrast film by which phase contrast became quarter wavelength in the broadband, and the refractive index of the direction of thickness was also controlled can be offered. Especially this is useful as a phase contrast film used for the reflective mold liquid crystal display of an one polarizing plate activity.

[0049]

[Equation 6]

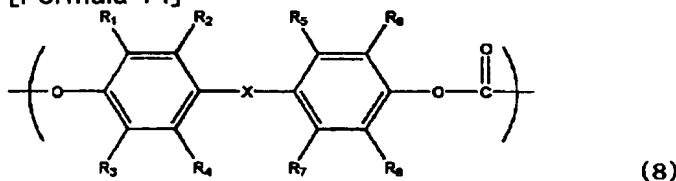
$$R(450)/R(550) < 1 \quad (5)$$

As for the phase contrast of a quarter wavelength plate, it is desirable that it is quarter wavelength on the high measurement wavelength of 550nm of human being's visibility, and 90-180nm is 110-170nm more preferably in $R(550)$.

[0050] If it is a polycarbonate as a phase contrast film which has the forward refractive-index anisotropy with which are satisfied of the above-mentioned formula (6), the polycarbonate which especially definition does not have, for example, uses bisphenol A as a bisphenol component, the polycarbonate which has a fluorene frame will be mentioned. This polycarbonate that has a fluorene frame is for example, the following type (8).

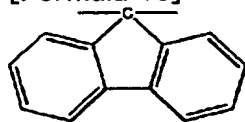
[0051]

[Formula 14]



[0052] (In the above-mentioned formula (8), R_1 - R_8 are independently chosen from the hydrocarbon group of a hydrogen atom, a halogen atom, and carbon numbers 1-6, respectively, and X is [0053].)

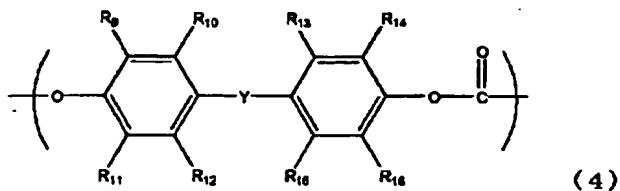
[Formula 15]



[0054]) come out. The repeat unit come out of and shown, and the following type (4)

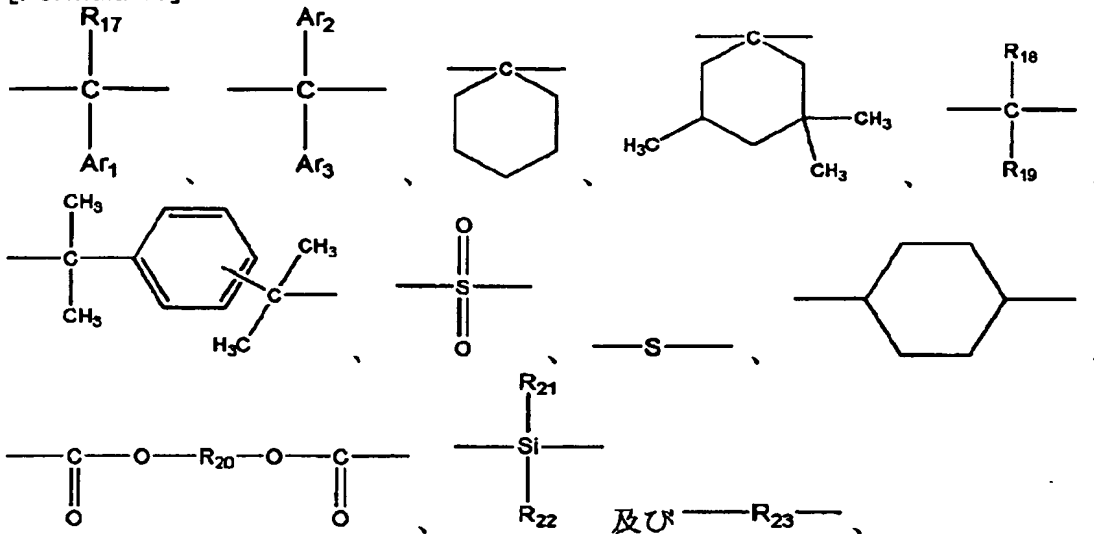
[0055]

[Formula 16]



[0056] (In the above-mentioned formula (4), R9-R16 are independently chosen from the hydrocarbon group of a hydrogen atom, a halogen atom, and carbon numbers 1-3, respectively, and Y is the following formula group [0057].)

[Formula 17]



[0058] The repeat unit which consists of a repeat unit shown by (a definition is the same as that of the above mentioned thing), and is expressed with the above-mentioned formula (8) occupies this 40 - 71-mol% of whole polycarbonate, and what the repeat unit expressed with the above-mentioned formula (4) becomes from the polycarbonate which occupies 60 - 29-mol % is mentioned. Of course, it is not limited to this.

[0059] As the manufacture approach of the polycarbonate in this invention, the interfacial polycondensation of a dihydroxy compound and a phosgene, a melt polycondensation method, etc. are used suitably.

[0060] Although a compatible blend is desirable when blending, it is possible to suppress light scattering between components, if the refractive index between components is doubled even if it does not dissolve thoroughly, and to raise transparency. Although a compatible blend is desirable when blending two or more kinds of polycarbonates, it is possible to suppress light scattering between components, if the refractive index between components is doubled even if it does not dissolve thoroughly, and to raise transparency. As for the acquired blend object, it is desirable that the Hayes value is 3% or less.

[0061] In the laminating phase contrast film of this invention, a refractive-index anisotropy may make the refractive-index maximum bearing within a field intersect perpendicularly, respectively, and may carry out the laminating of a negative phase contrast film and the phase contrast film which has a forward refractive-index anisotropy. This configuration corresponds, when both drawing directions are doubled when carrying out vertical uniaxial stretching also of forward and the phase contrast film which undertakes and has the refractive-index anisotropy of a gap, and producing it is considered, and a laminating is carried out. The phase contrast film which has a forward refractive-index anisotropy is because n_y intersects perpendicularly in the drawing direction in the refractive-index maximum bearing within a field in the negative phase contrast film which n_x is the drawing direction at least in the refractive-index maximum direction within a

field, and carries out refractive-index ***** on the other hand. That is, since the longitudinal direction which is the drawing direction is doubled by the low RUTSUU roll process with this configuration, there is an advantage that a layered product is producible with a low RUTSUU roll in the process which sticks the phase contrast film of these two classes.

[0062] As for the refractive-index anisotropy in this invention, in nx**ny, in a negative phase contrast film, especially definition does not have a laminating include angle with the phase contrast film which has a forward refractive-index anisotropy. In nx**ny, it is the case where the phase contrast value in the measurement wavelength of 550nm is 20nm or less.

[0063] By the case where carried out vertical incidence to the phase contrast film front face, and it measures, and the case where oblique incidence is carried out, although the phase contrast wavelength dispersion of the phase contrast film in this invention is usually almost the same, usually Forward [of this invention] and the layered product of a phase contrast film which has a negative refractive-index anisotropy can make these both into the greatly different thing, and can supply the phase contrast film which has the phase contrast wavelength dispersion of various classes according to the application of a liquid crystal display etc. The phase contrast wavelength dispersion said here points out the degree of the phase contrast value change measured in the measurement wavelength of 400–700nm. For example, it is $R(450)/R(550)$ which is a ratio with $R(450)$ and $R(550)$ which are a phase contrast value in the measurement wavelength of 450,550nm.

[0064] The phase contrast film of this invention can be manufactured by carrying out a laminating, after extending the film which consists of polymeric materials which were described above after film production or film production. Although a melting extrusion process well-known as a film producing-film method, the solution cast method, etc. are used, the solution cast method is more preferably used from viewpoints, such as thickness unevenness and an appearance. As a solvent in the solution cast method, a methylene chloride, dioxolane, etc. are used suitably.

[0065] Moreover, the drawing approach can also use the drawing approaches, such as vertical 1 well-known shaft, width 1 shaft, and biaxial stretching. The acid ester with which phthalic ester, such as dimethyl phthalate which is a well-known plasticizer, diethyl phthalate, and dibutyl phthalate, tributyl phosphate, etc. do not get into the film before a drawing in order to raise ductility, aliphatic series 2 base ester, a glycerol derivative, a glycol derivative, etc. can be blended. The organic solvent used at the time of film film production of point ** may be made to remain in a film, and may be extended. It is desirable that it is 1 – 20 % of the weight of polymer solid content comparison as an amount of this organic solvent.

[0066] It is desirable to carry out as drawing conditions for phase contrast film production in [of glass transition point temperature] –30 to +50 degrees C. This glass transition point temperature shall point out the glass transition point temperature in the condition that they were included, when additives, such as a solvent, are contained. It is the range of –10 to +20 degrees C of glass transition point temperature preferably. Moreover, when producing the phase contrast film which is nx**ny, one so-called common shaft and a biaxial-stretching process may be unnecessary only at a film production process.

[0067] Furthermore, in a phase contrast film, ultraviolet ray absorbents, such as a phenyl salicylic acid, a 2-hydroxy benzophenone, and triphenyl phosphate, the bluing agent for changing a tint, an antioxidant, etc. may be added.

[0068] It is desirable that it is 10 or less % of the weight of polymeric-materials comparison as an amount of the aforementioned additive. Although the retardation of a phase contrast film may be affected when these additives have the anisotropy optically, it is possible to make sufficient optical anisotropy discover only with polymeric materials in this invention.

[0069] As thickness of the above-mentioned (laminating) phase contrast film, although there is especially no limit, it is usually 30–200 micrometers preferably 400 micrometers from 1 micrometer.

[0070] The transparent thing of the phase contrast (laminating) film of this invention is desirable, it passes and it is desirable that $-ZU$ value is 3% or less, and total light transmission is 85% or more. Furthermore, a transparent and colorless thing is desirable and it is JIS. b^* is one or less more preferably 1.2 or less in the measurement using a 2 times visual field and illuminant C among the $L^*a^*b^*$ color coordinate systems of Z-8729 publication.

[0071] The laminating phase contrast film of this invention is good also as a reflective mold polarizing plate over which only the polarization of one side which consists of the polarization film containing dichroism absorbing matter, such as usual iodine and a color, a dielectric multilayer, or a cholesteric polymer liquid crystal is reflected or scattered, and a lamination phase contrast film one apparatus polarization film. In this case, it is possible to also improve the viewing-angle property of a polarization film.

[0072] Although a binder is required for mounting to a phase contrast film, a polarization film, and a liquid crystal display, a thing well-known as a binder is used. The middle thing of the refractive index of the film which carries out a laminating of the refractive index of a binder is desirable at the point of suppressing an interface echo.

[0073] Improvement in image quality is realizable by using the laminating phase contrast film and phase contrast film one apparatus polarization film which were mentioned above for a liquid crystal display etc. Moreover, the phase contrast film of this invention may be used instead of a glass substrate. In this case, when the optical member of a liquid crystal display can be reduced, since thickness which is the fault of a glass substrate can be made thin, it has the effectiveness that it is possible to prevent dotage of the image by the parallax resulting from the thickness of the glass which poses a problem especially with a reflective mold liquid crystal display, and it can compensate the crack easy of a glass substrate.

[0074] Moreover, the phase contrast film with which the laminating phase contrast film of this invention has a forward refractive-index anisotropy, and the phase contrast film which has a negative refractive-index anisotropy touch through a binder, and although the laminating is carried out, as for other optical members, close may be in between. For example, a forward-scattering film etc. may be installed as an optical member. These activity gestalt is determined according to an application.

[0075] Although the example of a configuration of the laminating phase contrast film of this invention is shown in drawing 2 -5, it is not limited to these. Moreover, although the above-mentioned forward one and the negative phase contrast film which a laminating phase contrast film constitutes can be used independently (one sheet), two or more sheets may be used.

[0076] The example which used the negative phase contrast film of this invention for the liquid crystal display is shown in drawing 6 and 7.

[0077] Drawing 6 shows the example of the reflective mold liquid crystal display with which the laminating phase contrast film was used, and configurations are the polarization film 5/the /polycarbonate laminating phase contrast film (quarter wavelength plate) 4/7/of /glass substrates, 8/of transparent electrodes, 9/of liquid crystal layers, 10/of concavo-convex reflectors and a glass substrate 11.

[0078] Drawing 7 shows the example of the super twist nematic transfective reflective mold liquid crystal display with which the phase contrast film which has a negative refractive-index anisotropy was used. A configuration The phase contrast film 1/19/of 15/of /glass substrates, 16/of transparent electrodes, 17/of liquid crystal layers, 18/of transfective reflectors, and glass substrates, and the forward refractive-index anisotropy which have phase contrast film 3 which have polarization film 12//forward-scattering film 13// negative refractive-index anisotropy// forward refractive-index anisotropy It is the phase contrast film 1/the /polarization film 21 which it has. In addition, the back light system under a polarization film was omitted.

[0079] In addition, in drawing 2 -7, 2 is an adhesive layer. Moreover, the orientation film for

liquid crystal, a thin film transistor, a light filter, etc. may be installed although omitted.

[0080]

[Example] Although an example is given to below and this invention is explained more to a detail, this invention is not limited to these.

[0081] (Appraisal method) The material property value of a publication in this description etc. is acquired by the following appraisal methods.

[0082] (1) Phase contrast R and K, a three-dimensions refractive index (n_x , n_y , n_z), the phase contrast R value that is the product of measurement birefringence Δn of Nz and Thickness d, K value, a three-dimensions refractive index, and Nz are measured by "M150" by Jasco Corp. which makes polarization analysis the phase contrast measurement means. The R value is measured in the condition that an incident ray and a film front face intersect perpendicularly, and is $R = \Delta n \cdot d = (n_x - n_y) \cdot d$. Moreover, by changing the include angle on an incident ray and the front face of a film, K value measures the phase contrast value in each include angle, calculates n_x , n_y , and n_z which are a three-dimensions refractive index by carrying out a curve fitting by the formula of a well-known index ellipsoid, and is calculating them by substituting for $K = (n_z - (n_x + n_y)/2) \cdot d$. in addition -- although average refractive-index $n = (n_x + n_y + n_z) / 3$ are needed as another parameter in that case -- the average refractive index n -- a spectrum -- "Abbe refractometer 2-T" made from ATAGO which is the ABBE refractive-index meter which the light source attached was used. Moreover, in the case of the layered product of a phase contrast film which has forward and a negative refractive-index anisotropy, it assumed similarly that it was an index ellipsoid, and evaluated to it. In the case of this layered product, the average refractive index should take the average of the average refractive index of each film which carries out a laminating, and thickness was taken as the sum of the thickness of each film.

[0083] The following formulas were used with the formula of an index ellipsoid. In addition, by the following formulas, d is thickness (nm) and theta is an angle of the direction of a film surface normal, and an incident ray to make.

[0084]

[Equation 7]

$R(\theta) = \Delta n(\theta)$ and $d / (1 - \sin^2 \theta / n^2) \cdot 0.5$ [0085] (a) It is [several 8] when a revolving shaft is a phase leading shaft. $\Delta n(\theta) = n_x - n_z / [(n_x^2 - n_z^2) \sin^2 \theta / n^2 + n_z^2] \cdot 0.5 - n_y$ [0086]

(b) It is [several 9] when a revolving shaft is a lagging axis.

$\Delta n(\theta) = n_x - n_y - n_z / [(n_y^2 - n_z^2) \sin^2 \theta / n^2 + n_z^2] \cdot 0.5$ [0087] (2) Measurement Japanese Industrial Standards JIS of total light transmission and a haze K According to 7105 "the optical characteristic test approach of plastics", it measured with the integrating-sphere type permeability measuring device. As assessment equipment, the color difference and the turbidity measuring instrument by Nippon Denshoku Industries Co., Ltd. ("COH-300A") were used.

[0088] (3) It measured by the proton NMR of "JNM-alpha600" by measurement JEOL Co., Ltd. of a macromolecule copolymerization ratio. In the case of the copolymer of bisphenol A and a bisque resol fluorene, it computed from the proton intensity ratio of each methyl group especially, using heavy benzene as a solvent.

[0089] (4) Measurement TA of the glass transition point temperature (T_g) of a macromolecule It measured by "DSC2920ModulatedDSC" made from Instruments. It measured in the state of flakes or a chip not after film shaping but after the resin polymerization.

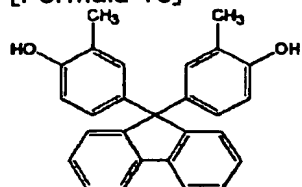
[0090] (5) It asked for limiting viscosity at 20 degrees C among the methylene chloride using limiting viscosity measurement Ubbelohde viscosity tubing of a giant molecule.

[0091] (6) It measured with the electronic micro by film thickness measurement ANRITSU CORP.

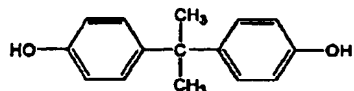
[0092] Moreover, the monomer structure of the polycarbonate used in the following examples and the example of a comparison is described below. Analysis of a polymer was performed using the proton NMR method.

[0093]

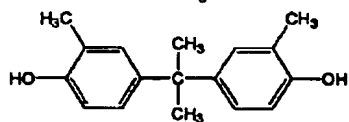
[Formula 18]



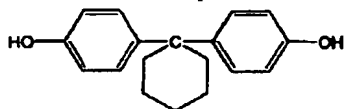
[A]



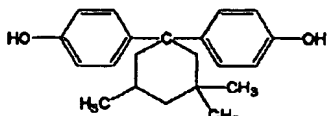
[B]



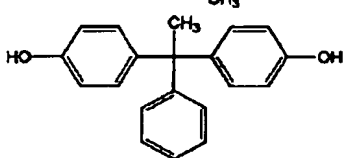
[C]



[D]



[E]



[F]

[0094] A sodium-hydroxide water solution and ion exchange water were taught to the reaction vessel equipped with the [example 1 of reference] agitator, the thermometer, and the reflux condenser, the monomer [A] and [B] which have the above-mentioned structure in this were dissolved by the mole ratio of a table 1, and a small amount of sodium hydrosulfite was added. Next, the methylene chloride was added to this and the phosgene was blown over about 60 minutes at 20 degrees C. Furthermore, after making p-tert-butylphenol add and emulsify, triethylamine was added, it stirred at 30 degrees C for about 3 hours, and the reaction was terminated. After [reaction termination] organic phase preparative isolation was carried out, the methylene chloride was evaporated, and the polycarbonate copolymer was obtained. The presentation ratio of the obtained copolymer was the same as that of a monomer charge ratio almost. This copolymer was dissolved in the methylene chloride and the dope solution of 19 % of the weight of solid content concentration was produced. The cast film was produced from this dope solution, and the phase contrast film was produced by making it dry in the condition of having made the dimension fixing. The property of this film is described in a table 1.

[0095] The polycarbonate copolymer was obtained by the same approach as the example 1 of reference except having used the monomer of [example 2 of reference] table 1 publication. The presentation ratio of the obtained copolymer was the same as that of a monomer charge ratio almost. The phase contrast film was produced like the example 1.

[0096] The polycarbonate copolymer was obtained by the same approach as the example 1 of reference except having used the monomer of [example 3 of reference] table 1 publication. The presentation ratio of the obtained copolymer was the same as that of a monomer charge ratio almost. This copolymer was dissolved in the methylene chloride and the dope solution of 19 % of the weight of solid content concentration was produced. The cast film was produced from this dope solution, after desiccation, uniaxial stretching was carried out to one the temperature scale factor [1.3 times scale factor of 241 degrees C of this] with the uniaxial-stretching machine, and the phase contrast film was obtained. A result is described in a table 1.

[0097] The polycarbonate copolymer was obtained by the same approach as the example 1 of reference except having used the monomer of [example 4 of reference] table 1 publication. The presentation ratio of the obtained copolymer was the same as that of a monomer charge ratio almost. This copolymer was dissolved in the methylene chloride and the dope solution of 20 % of the weight of solid content concentration was produced. The cast film was produced from this dope solution, and the phase contrast film was produced by making it dry in the condition of having made the dimension fixing. The property of this film is described in a table 1.

[0098] The polycarbonate copolymer was obtained by the same approach as the example 1 of reference except having used the monomer of [example 5 of reference] table 1 publication. The presentation ratio of the obtained copolymer was the same as that of a monomer charge ratio almost. This copolymer was dissolved in the methylene chloride and the dope solution of 20 % of the weight of solid content concentration was produced. The cast film was produced from this dope solution, after desiccation, uniaxial stretching was carried out to one the temperature scale factor [1.2 times scale factor of 241 degrees C of this] with the uniaxial-stretching machine, and the phase contrast film was obtained. A result is described in a table 1.

[0099] The polycarbonate copolymer was obtained by the same approach as the example 1 of reference except having used the monomer of [example 6 of reference] table 1 publication. The presentation ratio of the obtained copolymer was the same as that of a monomer charge ratio almost. This copolymer was dissolved in the methylene chloride and the dope solution of 20 % of the weight of solid content concentration was produced. The cast film was produced from this dope solution, and the phase contrast film was produced by making it dry in the condition of having made the dimension fixing. The property of this film is described in a table 1.

[0100] The polycarbonate copolymer was obtained by the same approach as the example 1 of reference except having used the monomer of [example 7 of reference] table 1 publication. The presentation ratio of the obtained copolymer was the same as that of a monomer charge ratio almost. This copolymer was dissolved in the methylene chloride and the dope solution of 20 % of the weight of solid content concentration was produced. The cast film was produced from this dope solution, after desiccation, uniaxial stretching was carried out to one the temperature scale factor [1.7 times scale factor of 245 degrees C of this] with the uniaxial-stretching machine, and the phase contrast film was obtained. A result is described in a table 1.

[0101]

[A table 1]

	参考例 1	参考例 2	参考例 3	参考例 4	参考例 5	参考例 6	参考例 7
モノマー1 構造 (仕込み量モル%)	[A] (81)	[A] (80)	[A] (81)	[A] (81)	[A] (75)	[A] (74)	[A] (80)
モノマー2 構造 (仕込み量モル%)	[B] (18)	[B] (14)	[B] (19)	[C] (19)	[D] (25)	[E] (26)	[F] (20)
構成等その他							
T _g (°C)	242	248	242	233	241	243	245
粘弾性度[η]	0.907	0.813	0.907	0.871	0.776	0.351	0.666
R(550) (nm)	-2.6	-2.7	-75.2	-7.2	-44.5	-8.6	-119.5
K(550) (nm)	82.6	82.5	48.2	41.4	22.4	34.7	56.6
平均屈折率 n(550)	1.626	1.626	1.626	1.621	1.623	1.615	1.628
n _x	1.62592	1.62581	1.62517	1.62111	1.62293	1.61509	1.62672
n _y	1.62594	1.62584	1.62649	1.62119	1.62333	1.61515	1.62927
n _z	1.62644	1.62665	1.62664	1.62160	1.62333	1.61537	1.62921
n _z	26.0	32.5	1.1	6.1	1.0	4.7	1.0
全光透過率(%)	90.1	90.2	90.3	90.0	90.0	90.6	90.1
ヘーズ(%)	0.5	0.2	0.4	0.4	0.4	0.5	0.6
膜厚(μm)	161.8	100.0	57.0	92.0	112.0	138.6	48.6

[0102] The polycarbonate gay polymer was obtained by the same approach as the example 1 of reference except having used the monomer of [example 1] table 1 publication. This gay polymer was dissolved in the methylene chloride, and the dope solution of 20 % of the weight of solid

content concentration was produced. The cast film was produced from this dope solution, after desiccation, uniaxial stretching was carried out to one the temperature scale factor [1.1 times scale factor of 161 degrees C of this] with the uniaxial-stretching machine, and the phase contrast film was obtained. A result is described in a table 1.

[0103] Furthermore, the drawing direction is doubled and this film and the phase contrast film produced in the example 1 of reference were stuck through the adhesive layer. The property of the layered product (laminating phase contrast film) is described in a table 1. In addition, incidence of the light was carried out from the film side produced in the example 1 of reference on the occasion of phase contrast measurement.

[0104] Moreover, a sample is rotated by setting a revolving shaft as the lagging axis of the phase contrast film which becomes drawing 1 from the above-mentioned polycarbonate gay polymer, and the above-mentioned layered product, and the phase contrast angular dependence at the time of changing theta whenever [incident angle] and measuring phase contrast is described. Although phase contrast will change if the phase contrast film which consists of a polycarbonate gay polymer changes whenever [incident angle], it turned out that this layered product that is $N_z=0.5$ is not based on whenever [incident angle], but it can check that phase contrast is fixed, and the angle-of-visibility property is improved.

[0105] The phase contrast film produced in the example 2 of [example 2] reference and the phase contrast film which consists of a polycarbonate gay polymer which consists of a monomer [A] produced in the example 1 were set for the drawing direction, and lamination and a layered product (laminating phase contrast film) were produced through the binder. The property of the layered product is described in a table 2.

[0106] The polycarbonate copolymer was obtained by the same approach as the example 1 of reference except having used the monomer of [example 3] table 2 publication. The presentation ratio of the obtained copolymer was the same as that of a monomer charge ratio almost. This copolymer was dissolved in the methylene chloride and the dope solution of 20 % of the weight of solid content concentration was produced. The cast film was produced from this dope solution, after desiccation, uniaxial stretching was carried out to one the temperature scale factor [2.0 times scale factor of 225 degrees C of this] with the uniaxial-stretching machine, and the phase contrast film was obtained. A result is described in a table 2. In addition, the relation of the phase contrast R (450), R (550), and R (650) in the measurement wavelength of 450nm of a basis phase reference film, 550nm, and 650nm is [0107].

[Equation 10] It turned out that an $R(450)/R(550) = 0.77R(650) / R(550) = 1.08$, and short wavelength side is the film with which a phase contrast value becomes small.

[0108] Through the binder, the drawing direction is doubled and the above-mentioned phase contrast film and the phase contrast film produced in the example 1 of reference were stuck. The property of the layered product is described in a table 2. In addition, incidence of the light was carried out from the film side produced in the example 1 of reference on the occasion of phase contrast measurement.

[0109] The polycarbonate copolymer was obtained by the same approach as the example 1 of reference except having used the monomer of [example 4] table 2 publication. The presentation ratio of the obtained copolymer was the same as that of a monomer charge ratio almost. This copolymer was dissolved in the methylene chloride and the dope solution of 19 % of the weight of solid content concentration was produced. The cast film was produced from this dope solution, after desiccation, uniaxial stretching was carried out to one the temperature scale factor [1.2 times scale factor of 207 degrees C of this] with the uniaxial-stretching machine, and the phase contrast film was obtained. The property of this film is described in a table 2. Moreover, the drawing direction is doubled and the phase contrast film and this film which were produced in the example 2 of reference were stuck through the binder. The property of this layered product is described in a table 2. In addition, incidence of the light was carried out from the film side produced in the example 2 of reference on the occasion of phase contrast

temperature scale factor [1.2 times scale factor of 245 degrees C of this] with the uniaxial-stretching machine, and the phase contrast film was obtained. A result is described in a table 3. Nz was about 1, and when the angular dependence of phase contrast which was performed in the example 1 was measured, it turned out that phase contrast changes.

[0115] The polycarbonate copolymer was obtained by the same approach as the example 1 of reference except having used the monomer of [example 11 of reference] table 3 publication.

The presentation ratio of the obtained copolymer was the same as that of a monomer charge ratio almost. This copolymer was dissolved in the methylene chloride and the dope solution of 16 % of the weight of solid content concentration was produced. The cast film was produced from this dope solution, after desiccation, uniaxial stretching was carried out to one the temperature scale factor [1.7 times scale factor of 225 degrees C of this] with the uniaxial-stretching machine, and the phase contrast film was obtained. A result is described in a table 3. Nz was about 1, and when the angular dependence of phase contrast which was performed in the example 1 was measured, it turned out that phase contrast changes.

[0116]

[A table 3]

	参考例 8	参考例 9	参考例 10	参考例 11
モノマー1 構造 (仕込み量モル%)	[A] (80)	[A] (83)	[A] (80)	[A] (45)
モノマー2 構造 (仕込み量モル%)	[C] (40)	[D] (37)	[E] (40)	[F] (55)
T _g (°C)	190	232	244	225
極限粘度[η]	0.821	0.632	0.692	0.998
R(550) (nm)	72.8	53.9	49.9	141.8
K(550) (nm)	-34.2	-28.1	-25.1	-70.3
平均屈折率 n(550)	1.603	1.618	1.609	1.612
n _x	1.60360	1.61840	1.60937	1.61294
n _y	1.60289	1.61780	1.60882	1.61153
n _z	1.60272	1.61781	1.60881	1.61153
Nz	1.0	1.0	1.0	1.0
全光線透過率(%)	90.5	90.7	90.8	90.2
ヘーズ(%)	0.8	0.9	0.9	0.8
膜厚(μm)	80.0	80.0	90.0	100.0

[0117]

[Effect of the Invention] As explained above, the polycarbonate laminating phase contrast film of this invention is excellent in thermal resistance, the moldability, the optical property, etc., and although it is usable in optical equipments, such as a liquid crystal display, even when it is independent, it has its outstanding effectiveness that it is usable even if it combines with other phase contrast films, and angle-of-visibility properties, such as a liquid crystal display, can be improved.

[Translation done.]

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TECHNICAL FIELD

[Field of the Invention] This invention relates to the phase contrast film by combining a phase contrast film with the negative refractive-index anisotropy which consists of a polycarbonate by which thermal resistance, a moldability, etc. were improved, and the phase contrast film which has the forward refractive-index anisotropy which consists of a polycarbonate which can control an angle-of-visibility property to arbitration according to an application. By using these phase contrast films, the liquid crystal display with which the optical property was improved can be offered.

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PRIOR ART

[Description of the Prior Art] In liquid crystal displays, such as a STN (super twisted nematic) method, the phase contrast film is used in order to solve problems, such as color compensation and angle-of-visibility amplification. Generally, as an ingredient of the phase contrast plate for color compensation, a polycarbonate, polyvinyl alcohol, polysulfone, polyether sulphone, amorphous polyolefine, etc. are used, and what stiffened a liquid crystal polymer and discotic liquid crystal in addition to the ingredient described above as a charge of a phase contrast plate for angle-of-visibility amplification is used.

[0003] Generally, in the case of the polymeric materials which the anisotropy of the film obtained in the usual uniaxial stretching also turns into optically uniaxial, for example, have a forward refractive-index anisotropy, the phase contrast film using a thermoplastic high polymer film is difficult for the refractive index within a field to be higher than one, and to carry out only the refractive index of the direction of thickness, although the refractive-index anisotropy is made to discover according to a uniaxial-stretching process. Even if the refractive index within a field is higher than one and it cannot carry out the refractive index of the direction of thickness, there is an usable application, but when a phase contrast film performs improving the angle of visibility of a liquid crystal display, control of such a direction of thickness may be needed.

[0004] As an approach of making the refractive index of the direction of thickness high, the approach of extending in the direction of thickness, the approach of carrying out the laminating of a phase contrast film with a negative refractive-index anisotropy and the phase contrast film with a forward refractive-index anisotropy, etc. are proposed, for example.

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EFFECT OF THE INVENTION

[Effect of the Invention] As explained above, the polycarbonate laminating phase contrast film of this invention is excellent in thermal resistance, the moldability, the optical property, etc., and although it is usable in optical equipments, such as a liquid crystal display, even when it is independent, it has its outstanding effectiveness that it is usable even if it combines with other phase contrast films, and angle-of-visibility properties, such as a liquid crystal display, can be improved.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, the approach of extending in the direction of thickness has the problem that cost will get [productivity] dramatically bad remarkably highly. Moreover, in the approach of carrying out the laminating of a phase contrast film with a negative refractive-index anisotropy, and the phase contrast film with a forward refractive-index anisotropy, the technique using that to which vertical orientation of polystyrene, polymethylmethacrylate, or the polymer liquid crystal was carried out is indicated as a phase contrast film which has a negative refractive-index anisotropy. However, as for the film which has these negative refractive-index anisotropies, it was actual for a moldability to have needed many [a scarce thing / and] complicated orientation processings for thermal endurance like a bad polymer liquid crystal, and for there to have been problems, like the ingredient cost itself is high, and to have not appeared on the market in a commercial scene. [0006] This invention solves the above-mentioned technical problem, and thermal resistance, a moldability, etc. are to offer the phase contrast film using a good polycarbonate with which the angle-of-visibility property has been improved.

[Translation done.]

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MEANS

[Means for Solving the Problem] Although this invention persons are examining widely the ingredient which has the outstanding optical property, since a phase contrast film is an optical application, in the measurement wavelength, 140 degrees C or more have observed polymeric materials, especially thermoplastic polymeric materials as glass transition point temperature as the ingredient which has 150 degrees C or more more preferably, and an advantageous ingredient in respect of a moldability from an ingredient with it, and a heat-resistant viewpoint. [there is little optical absorption and transparent]

[0008] When it had a certain specific macromolecule structure among polycarbonates, this invention persons found out that a negative refractive-index anisotropy might be made to discover, though the moldability was also good, having thermal resistance.

[0009] That is, this invention is a polycarbonate laminating phase contrast film characterized by consisting of a layered product of a phase contrast film which has the forward refractive-index anisotropy to which the three-dimensions refractive index in the wavelength of 550nm serves as a phase contrast film which has the negative refractive-index anisotropy which the three-dimensions refractive index in the wavelength of 550nm becomes from the polycarbonate with which are satisfied of the following type (1) from the polycarbonate with which are satisfied of the following type (2).

[0010]

[Equation 3] $n_x < n_z$ (1)

$n_x > n_z$ (2)

(n_x is the refractive index of the main drawing direction in a film plane among the above-mentioned formula (3), and n_z is the refractive index of the direction of a normal to a film plane.)

[0011] Although prescribed by the three-dimensions refractive index, first of all, this three-dimensions refractive index is explained to be the refractive-index anisotropy said by this invention. The refractive index n_z of bearing where a three-dimensions refractive index is expressed with n_x , n_y , and n_z , and each definition intersects perpendicularly in the main drawing direction in the refractive-index n_y :film plane of the main drawing direction in n_x :film plane: Consider as the refractive index of the direction of a normal on the front face of a film. Here, in the case of uniaxial stretching, the main drawing direction means the drawing direction and the direction extended so that the amount of preferred orientation might go up more in the case of biaxial stretching, and points out the direction of orientation of a macromolecule principal chain in chemical structure. It is expressed a negative refractive-index anisotropy like $n_x < n_z$ here using these three-dimensions refractive index.

[0012] Although this three-dimensions refractive index is measured by the polarization analysis which is the technique of analyzing the polarization condition of the outgoing radiation light obtained by carrying out incidence of the polarization to a phase contrast film, it is asking for this three-dimensions refractive index in this invention by the approach of considering that the

optical anisotropy of a phase contrast film is an index ellipsoid, and searching for by the formula of a well-known index ellipsoid. In addition, measurement wavelength was set to 550nm as long as there was especially no notice.

[0013] By combining the phase contrast film which has such a negative refractive-index anisotropy with the phase contrast film which has a forward refractive-index anisotropy, the angle-of-visibility property of a phase contrast film of having a forward refractive-index anisotropy is improvable. It is expressed with $n_x > n_z$ the forward refractive-index anisotropy said here using the three-dimensions refractive index which carried out point **. Although the phase contrast film which has a forward refractive-index anisotropy as point ** was carried out does not become $n_z > n_x$ unless the special drawing approach that a refractive index becomes large in the direction of thickness is taken instead, it becomes possible [making n_z substantially larger than both n_x and n_y within a field] by carrying out a laminating to the phase contrast film which has the negative refractive-index anisotropy which is $n_x < n_z$.

[0014] It can be evaluated by considering that this layered product is an index ellipsoid, and measuring it with the polarization analysis of point **, whether n_z of this laminating phase contrast film (it may be called a layered product) became substantially larger than both n_x and n_y within a field here.

[0015] It is the following formula (6) as an approach of writing an optical anisotropy using the three-dimensions refractive index of a phase contrast film.

[0016]

[Equation 4]

$$N_z = (n_x - n_z) / (n_x - n_y) \quad (6)$$

$N_z = 0.5$ from which a phase contrast value hardly changes even if it is $N_z \geq 1$, i.e., $n_x > n_y \geq n_z$, or $n_x \geq n_y > n_z$ by the usual approach and sees from across the film with which ***** consists of polymeric materials which have a forward refractive-index anisotropy are difficult to attain uniaxial stretching or only by carrying out biaxial stretching. Although it is required to become $n_x > n_z > n_y$ for making it $N_z = 0.5$, if it is the layered product of point **, it is possible to attain this, and it is the description that this layered product can control an optical anisotropy in $N_z < 1$. For example, rather than the case of $N_z = 1$, although based also on the optical design of a liquid crystal display, when the phase contrast film which becomes $N_z = 0.5$ is used for a liquid crystal display, if it has the same phase contrast within a field, the effectiveness that the angle of visibility of a liquid crystal display is improved is known.

[0017] Moreover, when each phase contrast film which has forward and a negative refractive-index anisotropy like this invention consists of a polycarbonate, while each film is excellent in thermal endurance, since it consists of similar polymeric materials, it is possible for selection of a binder to be also easy and for the endurance of a layered product to also raise it.

[0018]

[Embodiment of the Invention] This invention is characterized by consisting of a layered product of the phase contrast film which has the negative refractive-index anisotropy which the three-dimensions refractive index measured on the measurement wavelength of 550nm becomes from the polycarbonate with which are satisfied of the following formula (1), and the phase contrast film which has the forward refractive-index anisotropy which consists of a polycarbonate with which are satisfied of the following type (2) which consists of at least one or more sheets, respectively.

[0019]

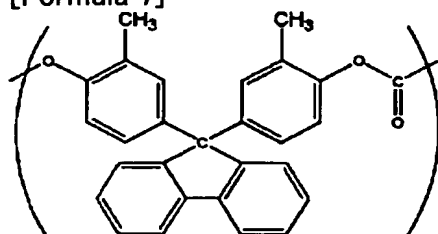
[Equation 5] $n_x < n_z$ (1)

$n_x > n_z$ (2)

It is that the above-mentioned formula (1) and (2) are realized on any [450,550,650nm] wavelength preferably as measurement wavelength. If the polycarbonate of the above-mentioned formula (1) is satisfied and carried out, it is the following type (3), for example.

[0020]

[Formula 7]

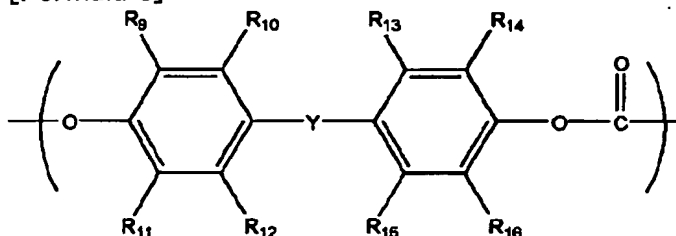


(3)

[0021] The repeat unit come out of and shown, and the following type (4)

[0022]

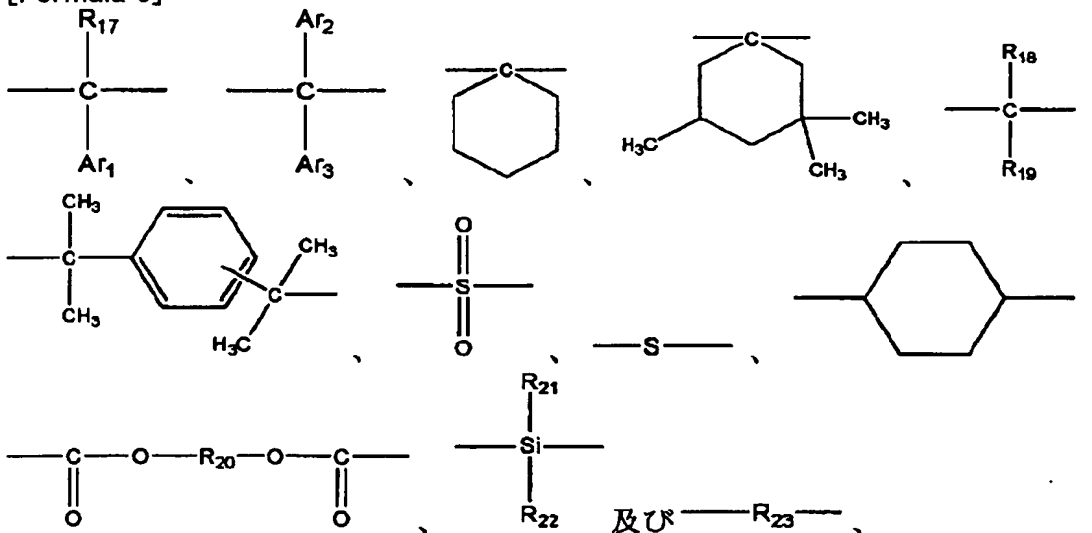
[Formula 8]



(4)

[0023] (In the above-mentioned formula (4), R9-R16 are independently chosen from the hydrocarbon group of a hydrogen atom, a halogen atom, and carbon numbers 1-3, respectively, and Y is the following formula group [0024].)

[Formula 9]



[0025] (--- R17-R19, and R21 and R22 are independently chosen from the hydrocarbon group of a hydrogen atom, a halogen atom, and carbon numbers 1-22 among the above-mentioned formula group, respectively, and R20 and R23 are independently chosen from the hydrocarbon group of carbon numbers 1-20, respectively, and Ar1-Ar3 are independently chosen from the aryl group of carbon numbers 6-10, respectively.) --- the polycarbonate which consists of a repeat unit shown can be mentioned.

[0026] The above-mentioned formula (3) is a repeat unit with the fluorene frame which has a methyl group.

[0027] Among the above-mentioned formula (4), as being independently chosen out of the hydrocarbon group of a hydrogen atom, a halogen atom, and carbon numbers 1-3, respectively, R9-R16 are kinds as it is few. A fluorine, chlorine, a bromine, and iodine can be mentioned as a halogen atom. As a hydrocarbon group of carbon numbers 1-3, alkyl groups, such as a methyl

group, an ethyl group, n-propyl group, and an isopropyl group, etc. can be mentioned. In this, all of R9-R16 have a desirable hydrogen atom. Y is chosen from the above-mentioned formula group. Among the above-mentioned formula group, as being independently chosen out of the hydrocarbon group of a hydrogen atom, a halogen atom, and carbon numbers 1-22, respectively, R17-R19, and R21 and R22 are kinds as it is few. The same thing as what was described above as a halogen atom can be mentioned. As a hydrocarbon group of carbon numbers 1-22, the aryl group of the carbon numbers 6-18, such as an alkyl group (cyclo) of the carbon numbers 1-22, such as a methyl group, an ethyl group, n-propyl group, an isopropyl group, butyl, a pentyl radical, and a cyclohexyl radical, a phenyl group, a biphenyl radical, a terphenyl radical, and naphthyl, can be mentioned.

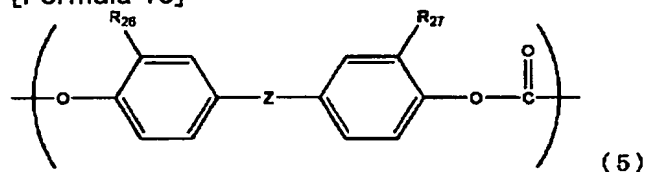
[0028] R20 and R23 can mention the divalent arylene radical of the carbon numbers 6-18, such as a divalent alkylene group (cyclo) of the carbon numbers 2-20, such as ethylene, a phenyl group, a biphenyl radical, a terphenyl radical, and a naphthyl group, as this hydrocarbon group that is independently chosen from the hydrocarbon group of carbon numbers 1-20, respectively and that is a kind at least.

[0029] Moreover, Ar1-Ar3 can mention the aryl group of the carbon numbers 6-10, such as a phenyl group and a naphthyl group, independently, respectively.

[0030] The above-mentioned polycarbonate is [the repeat unit shown by the above-mentioned formula (3), and] the following formula (5) more preferably.

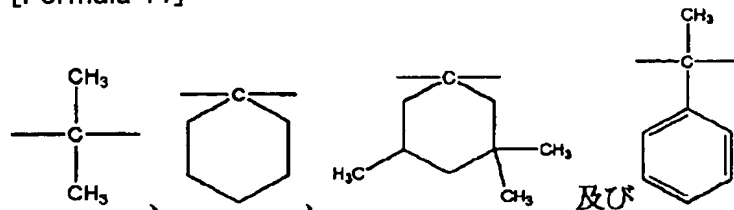
[0031]

[Formula 10]



[0032] (In the above-mentioned formula (5), R26 and R27 are independently chosen from a hydrogen atom and a methyl group, respectively. being a kind at least. Z the following formula group [0033])

[Formula 11]



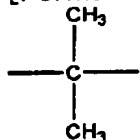
[0034] It comes out and consists of repeat units shown.

[0035] As for the repeat unit which the repeat unit expressed with the above-mentioned formula (3) occupies 71 - 98-mol % based on the sum total of the repeat unit expressed with this whole polycarbonate (3), i.e., the above-mentioned formula, and (4), and is expressed with the above-mentioned formula (4), it is desirable to consist of a polycarbonate which occupies 29 - two-mol %. Although, as for the repeat unit of the above-mentioned formula (3), its homopolymer also has a negative refractive-index anisotropy, there is a problem that productivity is inferior since the polymerization is difficult when there is too more this than the above-mentioned range, and a moldability worsens. Moreover, it may be difficult for a unit (3) to take a negative refractive-index anisotropy repeatedly, from the above-mentioned range, in being few. the repeat unit expressed with the above-mentioned formula (3) -- this 72 - 96-mol% of whole polycarbonate -- occupying -- the above-mentioned formula (4) -- (-- the repeat unit preferably expressed with (5)) consists of a polycarbonate which occupies 28 - four-mol %. the repeat unit expressed with the above-mentioned formula (3) still more preferably -- this 73 -

94-mol% of whole polycarbonate -- occupying -- the above-mentioned formula (4) -- (the repeat unit preferably expressed with (5)) consists of a polycarbonate which occupies 27 - six-mol %.

[0036] It is [the repeat unit expressed with the above-mentioned formula (1) and] the above-mentioned formula (2) (however, Z the following type [0037]) most preferably.

[Formula 12]



[0038] coming out -- it is -- it consists of a repeat unit expressed, the repeat unit expressed with the above-mentioned formula (1) occupies this 76 - 90-mol% of whole polycarbonate, and the repeat unit expressed with the above-mentioned formula (2) occupies 24 - ten-mol %.

[0039] Each may be any of the blend of a copolymer and homopolymers, the blend of copolymerization, and the blend with a homopolymer and a copolymer, and, in the case of a negative refractive-index anisotropy, the above-mentioned forward and negative phase contrast film has just satisfied the range of the above-mentioned repeat unit. It is analyzed by H-NMR etc. whether the above-mentioned repeat unit is satisfied.

[0040] In copolymerization, especially the interfacial polycondensation of a dihydroxy compound and a phosgene, the above-mentioned polycarbonate has the advantage that moreover those copolymerization ratios are controllable only by changing a monomer charge simple to arbitration, when it is going to produce what consists of two or more kinds of repeat units. On the other hand, in the case of polyester or polyarylate, there is a point disadvantageous when controlling the optical property that the equivalent [every] polymerization of a dihydroxy compound and the dicarboxylic acid must be carried out. In order to produce the phase contrast film on which thermal resistance and a moldability were satisfied, having a negative refractive-index anisotropy, close needs to be at a rate which has a certain specific repeat unit as mentioned above, and the polycarbonate is useful also from a viewpoint on such a molecular design.

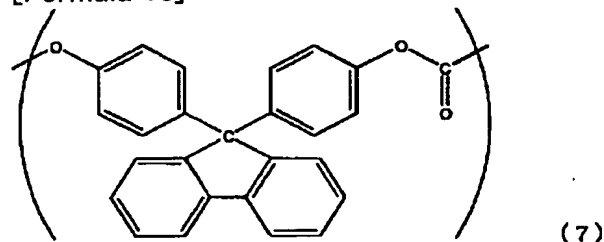
[0041] In addition, although, as for the refractive-index anisotropy of polymeric materials, the most is determined by the chemical structure, a certain extent may be changed also by the extending method or the producing-film method.

[0042] Although prescribed as molecular weight of the above-mentioned polycarbonate by the limiting viscosity measurement which used the methylene chloride as the solvent, it is desirable that the limiting viscosity in 20 degrees C is 0.30 - 2.0 dl/g.

[0043] Although there are an above-mentioned formula (3) and the following formula (7) which has a fluorene frame in the thing of similar structure, when there are many these repeat units, since it is more nearly upright than the case where the above-mentioned formula (3) is used, glass transition point temperature may become high and may become still more inadequate [a moldability].

[0044]

[Formula 13]



[0045] As for the phase contrast film which has the above-mentioned negative refractive-index

anisotropy, in short wavelength, in the wavelength of 400–700nm, the phase contrast value R ($R = \Delta n \cdot d$ ($n_x - n_y$), and d and d are the thickness (nm) of a film) more nearly usually shows large wavelength dispersion nature.

[0046] the phase contrast film which has a forward refractive-index anisotropy by carrying out the laminating of the phase contrast film which has the above-mentioned negative refractive-index anisotropy, and the phase contrast film which has a forward refractive-index anisotropy according to this invention -- if independent, the optical property almost equivalent to the film with which n_z has the larger property of n_x and n_y at least than either which cannot reach easily can be obtained.

[0047] If it is a polycarbonate as an ingredient of the phase contrast film which has the forward refractive-index anisotropy with which the above-mentioned formula (2) is filled, there will be especially no definition. What has the repeat unit of the above-mentioned formula (4) is used suitably. Of course, you may be copolymerization and a blend.

[0048] Moreover, when the relation of the phase contrast values R (450) and R (550) in the measurement wavelength of 450,550nm of the phase contrast film which has a forward refractive-index anisotropy carries out the laminating of the polycarbonate phase contrast film which has a negative refractive-index anisotropy to what is expressed with the following formula (6), the phase contrast film by which phase contrast became quarter wavelength in the broadband, and the refractive index of the direction of thickness was also controlled can be offered. Especially this is useful as a phase contrast film used for the reflective mold liquid crystal display of an one polarizing plate activity.

[0049]

[Equation 6]

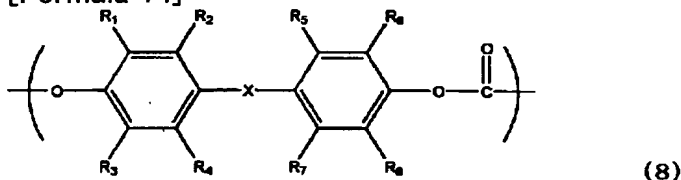
$$R(450)/R(550) < 1 \quad (5)$$

As for the phase contrast of a quarter wavelength plate, it is desirable that it is quarter wavelength on the high measurement wavelength of 550nm of human being's visibility, and 90–180nm is 110–170nm more preferably in R (550).

[0050] If it is a polycarbonate as a phase contrast film which has the forward refractive-index anisotropy with which are satisfied of the above-mentioned formula (6), the polycarbonate which especially definition does not have, for example, uses bisphenol A as a bisphenol component, the polycarbonate which has a fluorene frame will be mentioned. This polycarbonate that has a fluorene frame is for example, the following type (8).

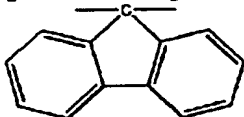
[0051]

[Formula 14]



[0052] (In the above-mentioned formula (8), R_1 – R_8 are independently chosen from the hydrocarbon group of a hydrogen atom, a halogen atom, and carbon numbers 1–6, respectively, and X is [0053].)

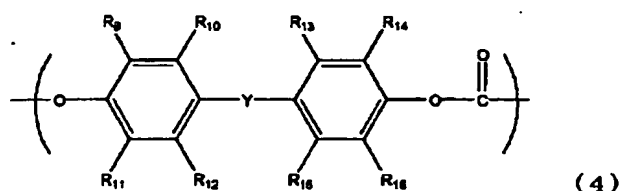
[Formula 15]



[0054]) come out. The repeat unit come out of and shown, and the following type (4)

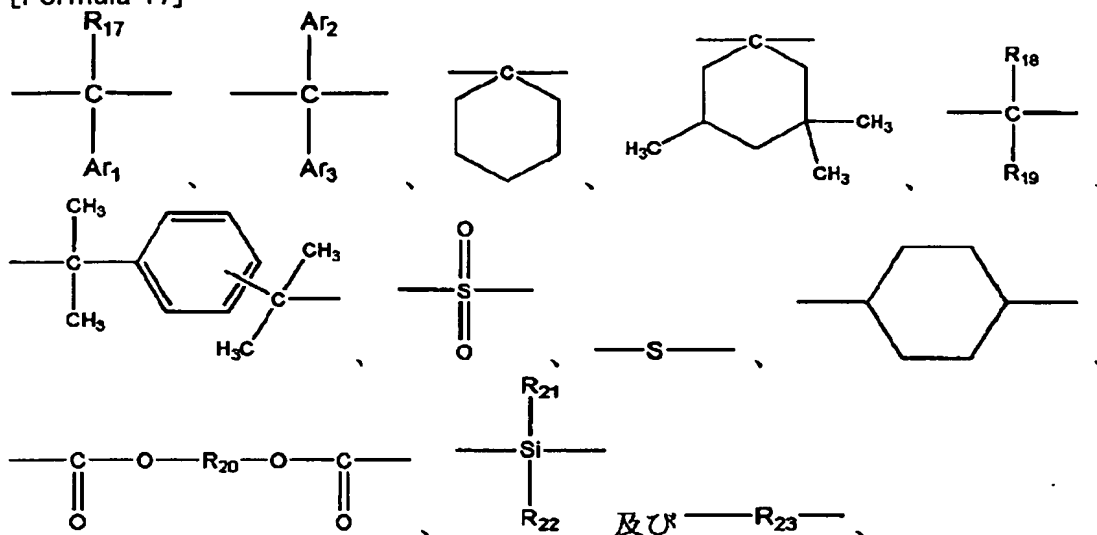
[0055]

[Formula 16]



[0056] (In the above-mentioned formula (4), R9-R16 are independently chosen from the hydrocarbon group of a hydrogen atom, a halogen atom, and carbon numbers 1-3, respectively, and Y is the following formula group [0057].)

[Formula 17]



[0058] The repeat unit which consists of a repeat unit shown by (a definition is the same as that of the above mentioned thing), and is expressed with the above-mentioned formula (8) occupies this 40 - 71-mol% of whole polycarbonate, and what the repeat unit expressed with the above-mentioned formula (4) becomes from the polycarbonate which occupies 60 - 29-mol % is mentioned. Of course, it is not limited to this.

[0059] As the manufacture approach of the polycarbonate in this invention, the interfacial polycondensation of a dihydroxy compound and a phosgene, a melt polycondensation method, etc. are used suitably.

[0060] Although a compatible blend is desirable when blending, it is possible to suppress light scattering between components, if the refractive index between components is doubled even if it does not dissolve thoroughly, and to raise transparency. Although a compatible blend is desirable when blending two or more kinds of polycarbonates, it is possible to suppress light scattering between components, if the refractive index between components is doubled even if it does not dissolve thoroughly, and to raise transparency. As for the acquired blend object, it is desirable that the Hayes value is 3% or less.

[0061] In the laminating phase contrast film of this invention, a refractive-index anisotropy may make the refractive-index maximum bearing within a field intersect perpendicularly, respectively, and may carry out the laminating of a negative phase contrast film and the phase contrast film which has a forward refractive-index anisotropy. This configuration corresponds, when both drawing directions are doubled when carrying out vertical uniaxial stretching also of forward and the phase contrast film which undertakes and has the refractive-index anisotropy of a gap, and producing it is considered, and a laminating is carried out. The phase contrast film which has a forward refractive-index anisotropy is because n_y intersects perpendicularly in the drawing direction in the refractive-index maximum bearing within a field in the negative phase contrast film which n_x is the drawing direction at least in the refractive-index maximum direction within a

field, and carries out refractive-index ***** on the other hand. That is, since the longitudinal direction which is the drawing direction is doubled by the low RUTSUU roll process with this configuration, there is an advantage that a layered product is producible with a low RUTSUU roll in the process which sticks the phase contrast film of these two classes.

[0062] As for the refractive-index anisotropy in this invention, in nx**ny, in a negative phase contrast film, especially definition does not have a laminating include angle with the phase contrast film which has a forward refractive-index anisotropy. In nx**ny, it is the case where the phase contrast value in the measurement wavelength of 550nm is 20nm or less.

[0063] By the case where carried out vertical incidence to the phase contrast film front face, and it measures, and the case where oblique incidence is carried out, although the phase contrast wavelength dispersion of the phase contrast film in this invention is usually almost the same, usually Forward [of this invention] and the layered product of a phase contrast film which has a negative refractive-index anisotropy can make these both into the greatly different thing, and can supply the phase contrast film which has the phase contrast wavelength dispersion of various classes according to the application of a liquid crystal display etc. The phase contrast wavelength dispersion said here points out the degree of the phase contrast value change measured in the measurement wavelength of 400–700nm. For example, it is $R(450)/R(550)$ which is a ratio with $R(450)$ and $R(550)$ which are a phase contrast value in the measurement wavelength of 450,550nm.

[0064] The phase contrast film of this invention can be manufactured by carrying out a laminating, after extending the film which consists of polymeric materials which were described above after film production or film production. Although a melting extrusion process well-known as a film producing-film method, the solution cast method, etc. are used, the solution cast method is more preferably used from viewpoints, such as thickness unevenness and an appearance. As a solvent in the solution cast method, a methylene chloride, dioxolane, etc. are used suitably.

[0065] Moreover, the drawing approach can also use the drawing approaches, such as vertical 1 well-known shaft, width 1 shaft, and biaxial stretching. The acid ester with which phthalic ester, such as dimethyl phthalate which is a well-known plasticizer, diethyl phthalate, and dibutyl phthalate, tributyl phosphate, etc. do not get into the film before a drawing in order to raise ductility, aliphatic series 2 base ester, a glycerol derivative, a glycol derivative, etc. can be blended. The organic solvent used at the time of film film production of point ** may be made to remain in a film, and may be extended. It is desirable that it is 1 – 20 % of the weight of polymer solid content comparison as an amount of this organic solvent.

[0066] It is desirable to carry out as drawing conditions for phase contrast film production in [of glass transition point temperature] –30 to +50 degrees C. This glass transition point temperature shall point out the glass transition point temperature in the condition that they were included, when additives, such as a solvent, are contained. It is the range of –10 to +20 degrees C of glass transition point temperature preferably. Moreover, when producing the phase contrast film which is nx**ny, one so-called common shaft and a biaxial-stretching process may be unnecessary only at a film production process.

[0067] Furthermore, in a phase contrast film, ultraviolet ray absorbents, such as a phenyl salicylic acid, a 2-hydroxy benzophenone, and triphenyl phosphate, the bluing agent for changing a tint, an antioxidant, etc. may be added.

[0068] It is desirable that it is 10 or less % of the weight of polymeric-materials comparison as an amount of the aforementioned additive. Although the retardation of a phase contrast film may be affected when these additives have the anisotropy optically, it is possible to make sufficient optical anisotropy discover only with polymeric materials in this invention.

[0069] As thickness of the above-mentioned (laminating) phase contrast film, although there is especially no limit, it is usually 30–200 micrometers preferably 400 micrometers from 1 micrometer.

[0070] The transparent thing of the phase contrast (laminating) film of this invention is desirable, it passes and it is desirable that - ZU value is 3% or less, and total light transmission is 85% or more. Furthermore, a transparent and colorless thing is desirable and it is JIS. b* is one or less more preferably 1.2 or less in the measurement using a 2 times visual field and illuminant C among the L*a*b* color coordinate systems of Z-8729 publication.

[0071] The laminating phase contrast film of this invention is good also as a reflective mold polarizing plate over which only the polarization of one side which consists of the polarization film containing dichroism absorbing matter, such as usual iodine and a color, a dielectric multilayer, or a cholesteric polymer liquid crystal is reflected or scattered, and a lamination phase contrast film one apparatus polarization film. In this case, it is possible to also improve the viewing-angle property of a polarization film.

[0072] Although a binder is required for mounting to a phase contrast film, a polarization film, and a liquid crystal display, a thing well-known as a binder is used. The middle thing of the refractive index of the film which carries out a laminating of the refractive index of a binder is desirable at the point of suppressing an interface echo.

[0073] Improvement in image quality is realizable by using the laminating phase contrast film and phase contrast film one apparatus polarization film which were mentioned above for a liquid crystal display etc. Moreover, the phase contrast film of this invention may be used instead of a glass substrate. In this case, when the optical member of a liquid crystal display can be reduced, since thickness which is the fault of a glass substrate can be made thin, it has the effectiveness that it is possible to prevent dotage of the image by the parallax resulting from the thickness of the glass which poses a problem especially with a reflective mold liquid crystal display, and it can compensate the crack easy of a glass substrate.

[0074] Moreover, the phase contrast film with which the laminating phase contrast film of this invention has a forward refractive-index anisotropy, and the phase contrast film which has a negative refractive-index anisotropy touch through a binder, and although the laminating is carried out, as for other optical members, close may be in between. For example, a forward-scattering film etc. may be installed as an optical member. These activity gestalt is determined according to an application.

[0075] Although the example of a configuration of the laminating phase contrast film of this invention is shown in drawing 2 -5, it is not limited to these. Moreover, although the above-mentioned forward one and the negative phase contrast film which a laminating phase contrast film constitutes can be used independently (one sheet), two or more sheets may be used.

[0076] The example which used the negative phase contrast film of this invention for the liquid crystal display is shown in drawing 6 and 7.

[0077] Drawing 6 shows the example of the reflective mold liquid crystal display with which the laminating phase contrast film was used, and configurations are the polarization film 5/the /polycarbonate laminating phase contrast film (quarter wavelength plate) 4/7/of /glass substrates, 8/of transparent electrodes, 9/of liquid crystal layers, 10/of concavo-convex reflectors and a glass substrate 11.

[0078] Drawing 7 shows the example of the super twist nematic transfective reflective mold liquid crystal display with which the phase contrast film which has a negative refractive-index anisotropy was used. A configuration The phase contrast film 1/19/of 15/of /glass substrates, 16/of transparent electrodes, 17/of liquid crystal layers, 18/of transfective reflectors, and glass substrates, and the forward refractive-index anisotropy which have phase contrast film 3 which have polarization film 12//forward-scattering film 13// negative refractive-index anisotropy// forward refractive-index anisotropy It is the phase contrast film 1/the /polarization film 21 which it has. In addition, the back light system under a polarization film was omitted.

[0079] In addition, in drawing 2 -7, 2 is an adhesive layer. Moreover, the orientation film for

liquid crystal, a thin film transistor, a light filter, etc. may be installed although omitted.

[Translation done.]

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EXAMPLE

[Example] Although an example is given to below and this invention is explained more to a detail, this invention is not limited to these.

[0081] (Appraisal method) The material property value of a publication in this description etc. is acquired by the following appraisal methods.

[0082] (1) Phase contrast R and K, a three-dimensions refractive index (nx, ny, nz), the phase contrast R value that is the product of measurement birefringence Δn of Nz and Thickness d, K value, a three-dimensions refractive index, and Nz are measured by "M150" by Jasco Corp. which makes polarization analysis the phase contrast measurement means. The R value is measured in the condition that an incident ray and a film front face intersect perpendicularly, and is $R = \Delta n \cdot d = (n_x - n_y) \cdot d$. Moreover, by changing the include angle on an incident ray and the front face of a film, K value measures the phase contrast value in each include angle, calculates nx, ny, and nz which are a three-dimensions refractive index by carrying out a curve fitting by the formula of a well-known index ellipsoid, and is calculating them by substituting for $K = (n_z - (n_x + n_y)/2) \cdot d$. in addition -- although average refractive-index $n = (n_x + n_y + n_z) / 3$ are needed as another parameter in that case -- the average refractive index n -- a spectrum -- "Abbe refractometer 2-T" made from ATAGO which is the ABBE refractive-index meter which the light source attached was used. Moreover, in the case of the layered product of a phase contrast film which has forward and a negative refractive-index anisotropy, it assumed similarly that it was an index ellipsoid, and evaluated to it. In the case of this layered product, the average refractive index should take the average of the average refractive index of each film which carries out a laminating, and thickness was taken as the sum of the thickness of each film.

[0083] The following formulas were used with the formula of an index ellipsoid. In addition, by the following formulas, d is thickness (nm) and theta is an angle of the direction of a film surface normal, and an incident ray to make.

[0084]

[Equation 7]

$R(\theta) = \Delta n(\theta)$ and $d / (1 - \sin^2 \theta / n^2) \geq 0.5$ [0085] (a) It is [several 8] when a revolving shaft is a phase leading shaft. $\Delta n(\theta) = n_x - n_z / [(n_x^2 - n_z^2) \sin^2 \theta / n^2 + n_z^2] \geq 0.5 - n_y$ [0086] (b) It is [several 9] when a revolving shaft is a lagging axis.

$\Delta n(\theta) = n_x - n_y - n_z / [(n_y^2 - n_z^2) \sin^2 \theta / n^2 + n_z^2] \geq 0.5$ [0087] (2) Measurement Japanese Industrial Standards JIS of total light transmission and a haze K According to 7105 "the optical characteristic test approach of plastics", it measured with the integrating-sphere type permeability measuring device. As assessment equipment, the color difference and the turbidity measuring instrument by Nippon Denshoku Industries Co., Ltd. ("COH-300A") were used.

[0088] (3) It measured by the proton NMR of "JNM-alpha600" by measurement JEOL Co., Ltd. of a macromolecule copolymerization ratio. In the case of the copolymer of bisphenol A and a bisque resol fluorene, it computed from the proton intensity ratio of each methyl group

especially, using heavy benzene as a solvent.

[0089] (4) Measurement TA of the glass transition point temperature (T_g) of a macromolecule It measured by "DSC2920ModulatedDSC" made from Instruments. It measured in the state of flakes or a chip not after film shaping but after the resin polymerization.

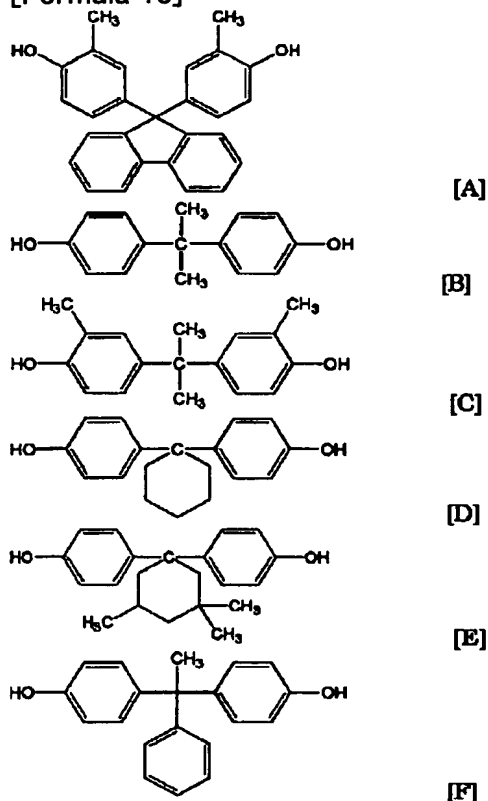
[0090] (5) It asked for limiting viscosity at 20 degrees C among the methylene chloride using limiting viscosity measurement Ubbelohde viscosity tubing of a giant molecule.

[0091] (6) It measured with the electronic micro by film thickness measurement ANRITSU CORP.

[0092] Moreover, the monomer structure of the polycarbonate used in the following examples and the example of a comparison is described below. Analysis of a polymer was performed using the proton NMR method.

[0093]

[Formula 18]



[0094] A sodium-hydroxide water solution and ion exchange water were taught to the reaction vessel equipped with the [example 1 of reference] agitator, the thermometer, and the reflux condenser, the monomer [A] and [B] which have the above-mentioned structure in this were dissolved by the mole ratio of a table 1, and a small amount of sodium hydrosulfite was added. Next, the methylene chloride was added to this and the phosgene was blown over about 60 minutes at 20 degrees C. Furthermore, after making p-tert-butylphenol add and emulsify, triethylamine was added, it stirred at 30 degrees C for about 3 hours, and the reaction was terminated. After [reaction termination] organic phase preparative isolation was carried out, the methylene chloride was evaporated, and the polycarbonate copolymer was obtained. The presentation ratio of the obtained copolymer was the same as that of a monomer charge ratio almost. This copolymer was dissolved in the methylene chloride and the dope solution of 19 % of the weight of solid content concentration was produced. The cast film was produced from this dope solution, and the phase contrast film was produced by making it dry in the condition of having made the dimension fixing. The property of this film is described in a table 1.

[0095] The polycarbonate copolymer was obtained by the same approach as the example 1 of

	参考例 1	参考例 2	参考例 3	参考例 4	参考例 5	参考例 6	参考例 7
モノマー1 構造 (仕込み量モル%)	[A] (81)	[A] (86)	[A] (81)	[A] (81)	[A] (75)	[A] (74)	[A] (80)
モノマー2 構造 (仕込み量モル%)	[B] (19)	[B] (14)	[B] (19)	[C] (19)	[D] (25)	[E] (26)	[F] (20)
構成モノその他							
T _g (°C)	242	248	242	233	241	243	245
相対粘度[η]	0.807	0.813	0.807	0.871	0.776	0.351	0.696
R(550) (nm)	-2.6	-2.7	-75.2	-7.2	-44.5	-8.6	-119.5
K(550) (nm)	82.6	82.5	48.2	41.4	22.4	34.7	58.6
平均屈折率n(550)	1.628	1.626	1.628	1.621	1.623	1.615	1.628
n _x	1.62562	1.62581	1.62517	1.62111	1.62293	1.61509	1.62672
n _y	1.62564	1.62584	1.62549	1.62119	1.62333	1.61515	1.62827
n _z	1.62644	1.62665	1.62684	1.62100	1.62333	1.61537	1.62921
N _z	26.0	32.5	1.1	6.1	1.0	4.7	1.0
全光線透過率(%)	90.1	90.2	90.3	90.0	90.0	90.8	90.1
ヘーズ(%)	0.5	0.2	0.4	0.4	0.4	0.5	0.6
膜厚(μm)	161.8	100.0	57.0	92.0	112.0	138.8	48.8

[0102] The polycarbonate gay polymer was obtained by the same approach as the example 1 of reference except having used the monomer of [example 1] table 1 publication. This gay polymer was dissolved in the methylene chloride, and the dope solution of 20 % of the weight of solid content concentration was produced. The cast film was produced from this dope solution, after desiccation, uniaxial stretching was carried out to one the temperature scale factor [1.1 times scale factor of 161 degrees C of this] with the uniaxial-stretching machine, and the phase contrast film was obtained. A result is described in a table 1.

[0103] Furthermore, the drawing direction is doubled and this film and the phase contrast film produced in the example 1 of reference were stuck through the adhesive layer. The property of the layered product (laminating phase contrast film) is described in a table 1. In addition, incidence of the light was carried out from the film side produced in the example 1 of reference on the occasion of phase contrast measurement.

[0104] Moreover, a sample is rotated by setting a revolving shaft as the lagging axis of the phase contrast film which becomes drawing 1 from the above-mentioned polycarbonate gay polymer, and the above-mentioned layered product, and the phase contrast angular dependence at the time of changing theta whenever [incident angle] and measuring phase contrast is described. Although phase contrast will change if the phase contrast film which consists of a polycarbonate gay polymer changes whenever [incident angle], it turned out that this layered product that is N_z=0.5 is not based on whenever [incident angle], but it can check that phase contrast is fixed, and the angle-of-visibility property is improved.

[0105] The phase contrast film produced in the example 2 of [example 2] reference and the phase contrast film which consists of a polycarbonate gay polymer which consists of a monomer [A] produced in the example 1 were set for the drawing direction, and lamination and a layered product (laminating phase contrast film) were produced through the binder. The property of the layered product is described in a table 2.

[0106] The polycarbonate copolymer was obtained by the same approach as the example 1 of reference except having used the monomer of [example 3] table 2 publication. The presentation ratio of the obtained copolymer was the same as that of a monomer charge ratio almost. This copolymer was dissolved in the methylene chloride and the dope solution of 20 % of the weight of solid content concentration was produced. The cast film was produced from this dope solution, after desiccation, uniaxial stretching was carried out to one the temperature scale factor [2.0 times scale factor of 225 degrees C of this] with the uniaxial-stretching machine, and the phase contrast film was obtained. A result is described in a table 2. In addition, the relation of the phase contrast R (450), R (550), and R (650) in the measurement wavelength of 450nm of a basis phase reference film, 550nm, and 650nm is [0107].

[Equation 10] It turned out that an $R(450)/R(550) = 0.77R(650) / R(550) = 1.08$, and short wavelength side is the film with which a phase contrast value becomes small.

[0108] Through the binder, the drawing direction is doubled and the above-mentioned phase contrast film and the phase contrast film produced in the example 1 of reference were stuck. The property of the layered product is described in a table 2. In addition, incidence of the light was carried out from the film side produced in the example 1 of reference on the occasion of phase contrast measurement.

[0109] The polycarbonate copolymer was obtained by the same approach as the example 1 of reference except having used the monomer of [example 4] table 2 publication. The presentation ratio of the obtained copolymer was the same as that of a monomer charge ratio almost. This copolymer was dissolved in the methylene chloride and the dope solution of 19 % of the weight of solid content concentration was produced. The cast film was produced from this dope solution, after desiccation, uniaxial stretching was carried out to one the temperature scale factor [1.2 times scale factor of 207 degrees C of this] with the uniaxial-stretching machine, and the phase contrast film was obtained. The property of this film is described in a table 2. Moreover, the drawing direction is doubled and the phase contrast film and this film which were produced in the example 2 of reference were stuck through the binder. The property of this layered product is described in a table 2. In addition, incidence of the light was carried out from the film side produced in the example 2 of reference on the occasion of phase contrast measurement.

[0110] The phase contrast film which consists of a polycarbonate gay polymer which consists of a monomer [A] produced in the [example 5] example 1, and the phase contrast film which consists of an example 3 of reference were stuck through the binder so that the drawing direction might intersect perpendicularly. The property of this layered product is described in a table 2.

[0111]

[A table 2]

	実施例1		実施例2		実施例3		実施例4		実施例5
モノマー1構造 (仕込み量モル%)	[A] (100)				[A] (67)		[B] (42)		
モノマー2構造 (仕込み量モル%)	-				[B] (33)		[C] (58)		
構成等その他		積層体	積層体		積層体		積層体	積層体	
T _g (°C)	180			226		205			
複屈折率[n _y]	0.532			0.581		0.524			
R(550) (nm)	138.8	136.2	136.2	160.4	163.4	137.4	140.5	214.1	
K(550) (nm)	-83.1	0.0	0.0	-75.0	0.0	-68.6	13.0	-37.0	
平均屈折率n(550)	1.588	1.607	1.607	1.628	1.628	1.570	1.598	1.607	
nx	1.58847	1.60708	1.60714	1.62586	1.62586	1.57053	1.59825	1.60758	
ny	1.58708	1.60654	1.60646	1.62455	1.62531	1.56900	1.59728	1.60620	
nz	1.58895	1.60880	1.60880	1.62459	1.62560	1.56900	1.59788	1.60664	
Nz	1.1	0.5	0.5	1.0	0.5	1.0	0.4	0.7	
全光透過率(%)	91.0	90.1	90.2	90.3	89.2	91.0	90.0	90.1	
ヘーズ(%)	0.3	0.6	0.5	0.3	0.6	0.5	0.6	0.7	
膜厚(μm)	100	281.9	200.0	122.0	283.9	89.5	146.6	157.0	

[0112] The polycarbonate copolymer was obtained by the same approach except having used the monomer of example 1 of the [example 8 of reference] reference, and table 3 publication. The presentation ratio of the obtained copolymer was the same as that of a monomer charge ratio almost. This copolymer was dissolved in the methylene chloride and the dope solution of 17 % of the weight of solid content concentration was produced. The cast film was produced from this dope solution, after desiccation, uniaxial stretching was carried out to one the temperature scale factor [1.2 times scale factor of 192 degrees C of this] with the uniaxial-stretching machine, and the phase contrast film was obtained. A result is described in a table 3. Although nz was larger than ny slightly, Nz was about 1, and when the angular

dependence of phase contrast which was performed in the example 1 was measured, it turned out that phase contrast changes.

[0113] The polycarbonate copolymer was obtained by the same approach as the example 1 of reference except having used the monomer of [example 9 of reference] table 3 publication. The presentation ratio of the obtained copolymer was the same as that of a monomer charge ratio almost. This copolymer was dissolved in the methylene chloride and the dope solution of 20 % of the weight of solid content concentration was produced. The cast film was produced from this dope solution, after desiccation, uniaxial stretching was carried out to one the temperature scale factor [1.2 times scale factor of 232 degrees C of this] with the uniaxial-stretching machine, and the phase contrast film was obtained. A result is described in a table 3. Although n_z was larger than n_y slightly, N_z was about 1, and when the angular dependence of phase contrast which was performed in the example 1 was measured, it turned out that phase contrast changes.

[0114] The polycarbonate copolymer was obtained by the same approach as the example 1 of reference except having used the monomer of [example 10 of reference] table 3 publication. The presentation ratio of the obtained copolymer was the same as that of a monomer charge ratio almost. This copolymer was dissolved in the methylene chloride and the dope solution of 20 % of the weight of solid content concentration was produced. The cast film was produced from this dope solution, after desiccation, uniaxial stretching was carried out to one the temperature scale factor [1.2 times scale factor of 245 degrees C of this] with the uniaxial-stretching machine, and the phase contrast film was obtained. A result is described in a table 3. N_z was about 1, and when the angular dependence of phase contrast which was performed in the example 1 was measured, it turned out that phase contrast changes.

[0115] The polycarbonate copolymer was obtained by the same approach as the example 1 of reference except having used the monomer of [example 11 of reference] table 3 publication. The presentation ratio of the obtained copolymer was the same as that of a monomer charge ratio almost. This copolymer was dissolved in the methylene chloride and the dope solution of 16 % of the weight of solid content concentration was produced. The cast film was produced from this dope solution, after desiccation, uniaxial stretching was carried out to one the temperature scale factor [1.7 times scale factor of 225 degrees C of this] with the uniaxial-stretching machine, and the phase contrast film was obtained. A result is described in a table 3. N_z was about 1, and when the angular dependence of phase contrast which was performed in the example 1 was measured, it turned out that phase contrast changes.

[0116]

[A table 3]

	参考例8	参考例9	参考例10	参考例11
モノマー1構造 (仕込み量モル%)	[A] (80)	[A] (83)	[A] (80)	[A] (45)
モノマー2構造 (仕込み量モル%)	[C] (40)	[D] (37)	[E] (40)	[F] (55)
T_g (°C)	190	232	244	225
極限粘度 $[\eta]$	0.821	0.632	0.682	0.968
R(550) (nm)	72.8	53.9	49.9	141.8
K(550) (nm)	-34.2	-28.1	-25.1	-70.3
平均屈折率 $n(550)$	1.603	1.618	1.609	1.612
n_x	1.60360	1.61840	1.60937	1.61294
n_y	1.60289	1.61760	1.60882	1.61153
n_z	1.60272	1.61781	1.60881	1.61153
N_z	1.0	1.0	1.0	1.0
全光線透過率(%)	90.5	90.7	90.8	90.2
ヘーズ(%)	0.8	0.9	0.9	0.8
膜厚(μm)	80.0	90.0	90.0	100.0

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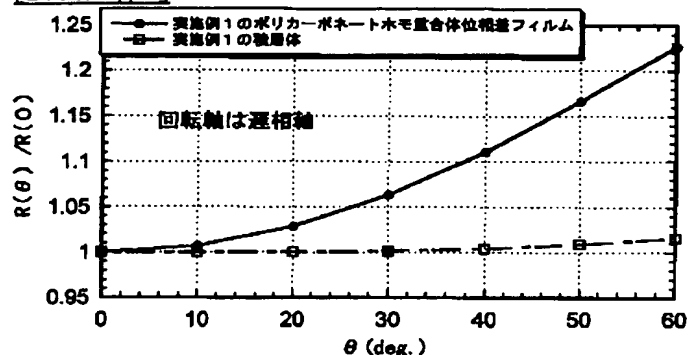
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DRAWINGS

[Drawing 1]



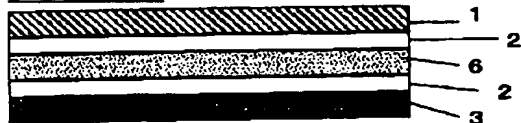
[Drawing 2]



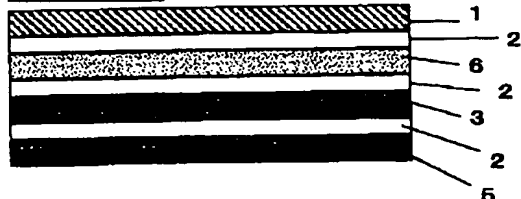
[Drawing 3]



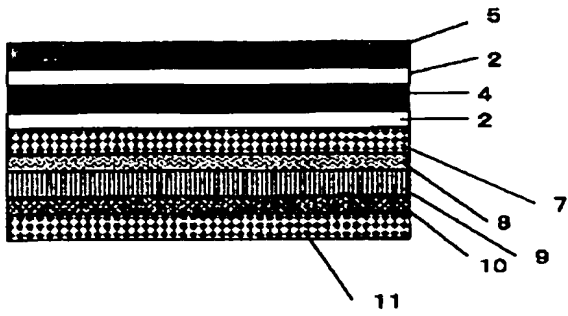
[Drawing 4]



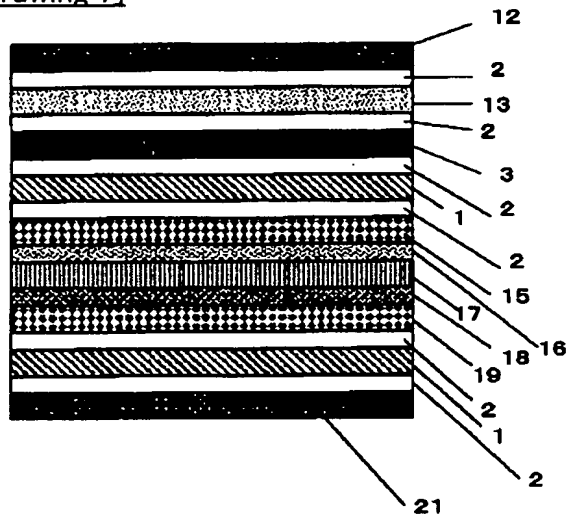
[Drawing 5]



[Drawing 6]



[Drawing 7]



[Translation done.]

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